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JOURNAL OF COATINGS TECHNOLOGY

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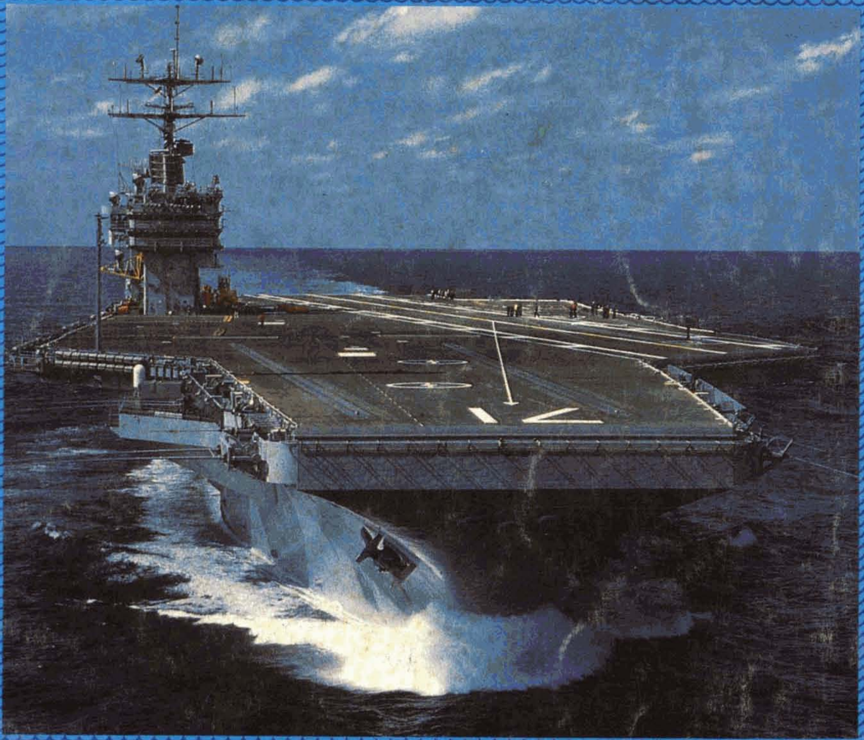
July 1989



Evaluation of Corrosion Methods for Magnesium

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JULY 1989

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VOLUME 61 NUMBER 774

Technical Articles

Federation News

Departments

THE JOURNAL OF COATINGS TECHNOLOGY (ISSN 0361-8773) is published monthly by the Federation of Societies for Coatings Technology, 1315 Walnut St., Philadelphia, PA 19107. Phone: (215) 545-1507.

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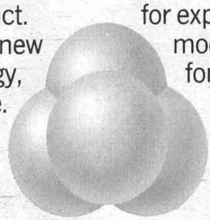

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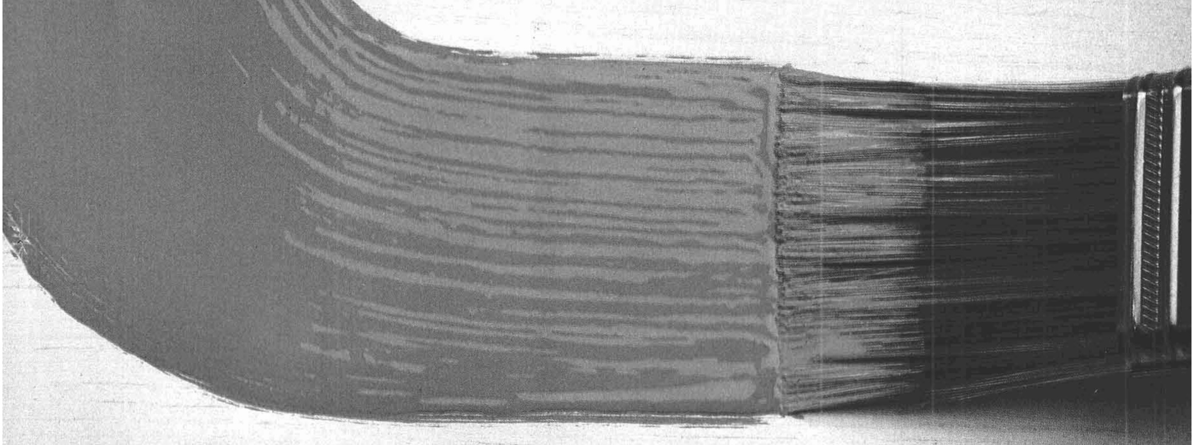

JOURNAL OF COATINGS TECHNOLOGY

1315 Walnut St., Phila., PA 19107

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The Federation of Societies for Coatings Technology assumes no responsibility for the opinions expressed by authors in this publication.

Comment

A Far West Orient

Society officers were hosted recently by the Federation at an orientation meeting, held in Los Angeles as part of ''FSCT Spring Week'' activities.

This meeting is an annual event affording officers the opportunity to exchange ideas with their counterparts from other Societies as well as with Federation officers and staff members. The full-day agenda covers a multitude of items in a format designed to encourage full participation.

In the lively discussions engendered, major expressions of interest at the local level focused on member recruitment/motivation, programming, and communications. The Society representatives expressed varied comments on these and other topics, all of which provided much food for thought to take back to their constituencies.

To cap off the meeting experience, the Society officers were invited to stay over for the Federation Board of Directors meeting the following day, and a goodly number did so to witness the deliberations of that body and gain a better insight into the workings of the Federation.

Those taking part were pleased with the opportunity to attend, and while none returned to their Societies with any magic cure for whatever local ills might exist, they did take with them a better understanding of the Society/Federation relationship and how both can cooperate to mutual advantage.

Thomas A. Kocis

Thomas A. Kocis,
Contributing Editor

Abstracts of Papers in This Issue

EVALUATION OF CORROSION PROTECTION METHODS FOR MAGNESIUM—F. Mansfeld, S. Kim, and S. Lin

Journal of Coatings Technology, 61, No. 774, 33 (July 1989)

The corrosion behavior of chrome-manganese conversion coated or anodized Mg AZ31 with an epoxy coating has been evaluated by electrochemical impedance spectroscopy (EIS) during exposure to 0.5 N NaCl. Samples coated with this commercial procedure survived exposure to 0.5 N NaCl for two months without pitting. The corrosion protection of coated Mg can be well characterized by using EIS.

INTERLABORATORY TESTING OF VISCOSITY IN THE LOW SHEAR RATE RANGE (BELOW 10 SEC^{-1})—CLEVELAND SOCIETY FOR COATINGS TECHNOLOGY

Journal of Coatings Technology, 61, No. 774, 41 (July 1989)

Viscosity profiles of six coatings samples, three solvent-based and three water-borne, were determined on a variety of viscometers both in a shear rate increasing and decreasing mode. Included were the Bohlin, Carri-Med, Contraves, Haake Rotovisco, and computer driven Weissenberg viscometers. Each sample was run in duplicate at 25°C. Log viscosity-log shear rate profiles for each sample run were fitted by second order regression. Using the regression coefficients, viscosities were extrapolated to 10.0, 1.0, and 0.1 sec^{-1}. Statistical analysis showed that the standard deviation of the average viscosity increased as shear rate decreased. Also, better agreement was seen between viscometers in the shear rate decreasing than the shear rate increasing mode. For comparison, manual Weissenberg, Brookfield relaxation, and Falling Needle Viscometer data is included.

See Pages 19-26 For Annual Meeting & Paint Show Information

LOW VOC COATINGS. GENERAL CONSIDERATIONS AND APPLICABILITY OF LIQUID CRYSTALLINE BINDERS—S.P. Pappas

Journal of Coatings Technology, 61, No. 774, 51 (July 1989)

This report begins with a general discussion of advantages and challenges relating to the formulation of low VOC coatings, introduces the potential for lowering VOCs of air-dry alkyds by incorporation of liquid crystalline (LC) groups, and proceeds to on-going studies at North Dakota State University on novel LC polymers and oligomers for coatings binders, highlighting the studies on air-dry alkyds and acrylic lacquers. The results of these studies demonstrate that LC binders form stable nonaqueous dispersions, which make them potentially attractive for low VOC coatings applications (as well as for reducing oven-sagging of baked coatings). The results further establish that LC binders provide unusual combinations of hardness and flexibility, together with good adhesion and fast dry (in the case of air-dry alkyds)—properties which are unattainable with corresponding amorphous binders.

DISSOLUTION RATES OF POLYMERS AND COPOLYMERS BASED ON METHYL, ETHYL, AND BUTYL METHACRYLATE—R.J. Groele and F. Rodriguez

Journal of Coatings Technology, 61, No. 774, 55 (July 1989)

The rate of dissolution (DR) of thin (1 μm) films of various methacrylate polymers was measured using laser interferometry. The polymers were all of high ($M_n > 600 \times 10^3$) molecular weight and included homopolymers of methyl methacrylate (MMA), ethyl methacrylate (EMA), and n-butyl methacrylate (BMA), as well as copolymers of MMA with EMA and with BMA. Glass transition temperatures (T_g) estimated by differential scanning calorimetry (DSC) ranged from 36°C [poly (n-butyl methacrylate)] (PBMA) to 115°C [poly (methyl methacrylate)] (PMMA). Films were applied to silicon wafers by conventional spinning and baking. The DRs in methyl isobutyl ketone (MIBK) at 30°C ranged from 0.042 μm/min (PMMA) to c. 150 μm/min (PBMA). Activation energy, E_a, in the limited span of 20-40° decreased as T_g decreased. In agreement with other workers, E_a for PMMA was 25 kcal/mol. However, the E_a dropped almost to half that value for poly (ethyl methacrylate) (PEMA) and for BMA-rich copolymers.

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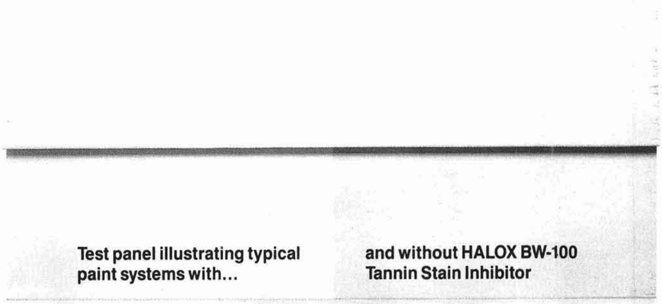
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Highlights of 1989 FSCT "Spring Week" Included Analytical Resources Seminar & Successful Meetings

Los Angeles and the Pacific Ocean provided the backdrop for the Federation's sixth Spring Week, another successful event highlighted by an outstanding seminar and productive meetings.

Events during the week were: *May 16-17*—FSCT Spring Seminar on "Modern Analytical Resources: The Coatings Chemist's Ally"; *May 18*—Incoming Society Officer's Meeting; *May 19*—Spring 1989 Board of Directors Meeting.

FSCT Spring Seminar

The one and one-half day program, presented under the auspices of the Federation's Professional Development Committee, focused on the practical application of the analytical techniques and problem-solving capabilities of modern instruments. The 47 attendees heard Keynote Speaker Dr. Clifford K. Schoff, of PPG Industries, Inc., discuss "The Philosophy of Problem-Solving in Coatings Science and Technology." Other topics included Analysis of Small Samples and Particulates; Use of Modern Analytical Techniques in the Paint Laboratory; X-Ray Analytical Methods; and presentations describing a variety of practical coating problems and giving examples of how specific instruments and techniques were used in their solution. Open Forum discussions indicated a high level of interest.

Society Officers Meeting

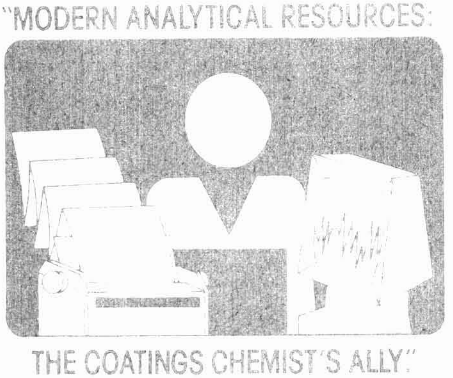
For the second straight year, all 26 Societies were represented at the annual orientation session sponsored by the Federation. This was the 13th such meeting and discussion of Federation and Society affairs was most informative for the Society Officers, Federation Officers, and Staff present.

Board of Directors Meeting

Attendance (58): Thirty-five members of the Board, plus 23 guests (including 5 Past-Presidents and 13 Society Officers from the previous day's meeting).

FSCT Financial Report: First Quarter Statement indicated that income and expense are in keeping with the budget of $2.3 million.

Annual Meeting and Paint Show: The 1988 AM&PS recorded the highest registered attendance (8,414) and exhibit space (69,760) in Federation history. The 1989 Paint Show is fully reserved, with exhibit space totaling over 74,000 net square feet. Programming Committee, under Chairman George Pilcher, is finalizing the technical program. We look forward to another successful meeting.



Nominations for 1989-90: The slate for 1989-90, presented by the Nominating Commitee, is:

President-Elect—Kurt F. Weitz, of Toronto
Treasurer—William F. Holmes, of Dallas
Executive Committee—Richard M. Hille, of Chicago (3 years)
Board (At Large)—John A. Lanning, of Louisville (2 years)
Colin D. Penny, of Baltimore (2 years)
Board (Past-President)—Carlos E. Dorris, of Dallas (2 years)

John Ballard, of Louisville, had already been elected to assume the Presidency on November 10.

There were no nominations from the floor. Elections will take place at the Fall 1989 Board Meeting in New Orleans, November 7.

Amendments to By-Laws: First reading was given to amending Article I, Section A, Paragraphs (2) and (3) regarding the continuance of rights of both Society and Federation Honorary Members to the class of membership to which they would otherwise be entitled.

Actions of the Executive Committee: Committee actions of October 21, 1988, January 19-20, 1989, and May 18, 1989 were approved by the Board.

FSCT Headquarters Building: President Geiger, Chairman of the Building Committee, reported that after considering over 20 possible locations, the Committee selected three candidate sites for additional study. Of these three, one is considered "best," and negotiations will proceed shortly. Additional details will follow the approval of the Executive Committee.

Society Business: The Mexico Society reported on the successful Statistical Process Control Seminar (Level II), held April 6-8. There were 46 attendees, and the Society did not require the $3,000 subsidy approved by the Board last fall. The Society expressed its appreciation to the Federation for its support.

Membership Chairman Horace Phillip announced that three Societies which achieved the biggest percentage gain in membership (by size of Society) will receive Certificates of Appreciation. They are Montreal, Kansas City, and Pacific Northwest.

The Birmingham Club announced that it will hold its 60th Anniversary Jubilee celebration on June 8, with a dinner to be attended by President and Mrs. Geiger, and invited Federation members to attend.

The Pacific Northwest Society, noting the large increase in airfares, requested that the Federation consider holding the Board Meeting in the spring on a Saturday to take advantage of the "over Saturday night" reductions in cost. A show of hands among the Board members revealed a unanimous assent to this request and it shall be considered for future meetings.

History Committee: A letter from Michael Malaga, Chairman of the FSCT History Committee, was distributed to the Board members. Mr. Malaga, a Past-President of the Federation, requested the Societies' assistance in gathering information on the Constituent Societies for compilation into an overall history of the Federation.

New Business: Incorporation of the Federation was discussed, and two resolutions enabling FSCT counsel to initiate the incorporation process were passed unanimously. The FSCT Constitution and By-Laws have been reformed into Articles of Incorporation and By-Laws, and these were distributed to the members prior to the meeting. A final vote on these will be taken at the Fall Board Meeting.

Honorary Memberships: Two Past-Presidents had been nominated for Federation Honorary Membership: Michael Malaga, of Cleveland, and John Oates, of New York. The nominations were approved by the Executive Committee and the proper notifications made. We are pleased to announce that both nominations gained unanimous approval by the Board. Congratulations Mike and John.

COMMITTEE REPORTS:

Professional Development—Chairman Dr. Richard Himics reported the committee's concern with severe analytical errors reported in proficiency testing. He said that the Committee will meet with representatives from ASTM and NPCA to make them aware of the problem. He also indicated that the membership survey will be repeated in order to assist the committee in designing better programs.

Educational—Chairman Sidney Lauren noted that the Hendry Award competition for best student papers will now accept submissions of papers with faculty advisor co-authorship. The papers may be of original research or topical review. A proposal from CalPoly will be considered by the committee at its June meeting. The proposal calls for a program ending with a B.S. Degree in Coatings Technology.

* * *

We sincerely thank the following for their assistance in holding the 1989 Spring events: The Professional Development Committee, and especially Sid Lauren, for their work in developing an outstanding seminar program; Mobay Corp., for its sponsorship of the Society Officers Reception; Eastman Chemical Products, Inc., for its sponsorship of the Board of Directors Reception; and the Los Angeles Society, for its sponsorship of the Board Luncheon Reception and its assistance in holding the Friday tour to Universal City Studios.

1989 Annual Meeting to Offer International Perspective On "Coatings Worldwide: Meeting the Needs of the Nineties"

New Orleans, a city whose heritage blends many cultures and customs, is an appropriate setting for the 1989 Annual Meeting of the Federation, which will focus on the theme, "Coatings Worldwide: Meeting the Needs of the Nineties." Three days of technical sessions, scheduled for November 8-10, at the New Orleans Hilton, have been developed by Program Chairman George R. Pilcher, of Hanna Chemical Coatings Corp., and members of his committee to explore varied topics of interest to personnel of the coatings industry internationally.

• To explore the impact of regulatory activity worldwide, a symposium will be offered on "Regulation in the Nineties." Planned topics and speakers include:

"Proposition 65 Update"—Patrick M. Meehan, Division Counsel, The Clorox Company, Oakland, CA

"The Regulatory Aspects of Coatings"—Dean Simeroth, California Air Resources Board, Sacramento, CA

"Health, Safety, and Legislation in the UK and Europe"—Kenneth Smith, Manager of Health and Safety, Cray Valley Products Limited, Waterloo Works Machen Newport, South Wales, UK

• A symposium on "Advanced Topics in Coatings Research" will be presented by the Professional Development Committee. Included in the presentations are the following:

"Collaboration—A European Approach to Research"—J.A. Bernie, Managing Director, The Paint Research Association, Teddington, Middlesex, England.

"Lasers, Light, and Liquid Crystalline Thin-Film Coatings"—C.E. Hoyle, M.A. Trapp, and C.P. Chawla, Department of Polymer Science, University of Southern Mississippi, Hattiesburg, MS

"Formation and Properties of Thermosetting and High Temperature Polymers"—John K. Gillham, Professor, Polymer Materials Program, Department of Chemical Engineering, Princeton University, Princeton, NJ

"Statistical Evaluation of Structure-Properties Relationships in Novel Automotive Clearcoat Concepts"—K.J.H. Kruithof and H.J.H. van den Haak, Automotive Finishes Research Center, Akzo Coatings Nederland bv, Sassenheim, The Netherlands

"A New Class of Radical Scavengers for Coatings"—M.S. Holt and Andrew Mar, Additives Division, CIBA-GEIGY Corp., Ardsley, NY.

• A symposium on "Raw Materials in the Nineties" will discuss the global outlook for raw materials. Speakers and topics include:

"Supply and Demand of Petrochemical Feedstocks Worldwide"—Ian Harris, Market Manager, Trade Polymers, Rohm and Haas Co., Philadelphia, PA

"Supply and Demand of Agricultural Feedstocks Worldwide"—William Reutz, General Sales Manager, International Oil Seed Processing, Cargill Incorporated, Minneapolis, MN

"Supply and Demand of TiO_2 Worldwide"—Wiley Greer, E.I. du Pont de Nemours & Co., Wilmington, DE.

• The uses of computers in meeting the needs of the coatings industry is the focus of a session in which Dr. Peter J. Hunt, of Productivity Management Consultants, Clearwater, FL, will present the plenary lecture (*See June, JCT*). Dr. Hunt's presentation is entitled, "A Quality Management for the 1990s." Additional topics to be discussed are:

"Measurement and Analysis of Coatings Properties"—T.F. Rehfeldt, The Sherwin-Williams Co., Chicago, IL

"The Color Computer Comes of Age"—James T. De Groff, of Colortec Associates, Inc., Oldwick, NJ.

• The Corrosion Committee will offer a symposium on "New Approaches to Corrosion Evaluation." Included in the presentations will be:

"The Mechanism of Degradation"—John Gerlock, Polymer Science Department, Ford Motor Co., Dearborn, MI

"Development of a Self-Priming Topcoat Using Theoretical and Statistical Formulation Design"—Charles R. Hegedus, Materials Engineer, Naval Air Development Center, Aerospace Materials Division, Warminster, PA

"Cyclic Methods of Accelerated Corrosion Testing"—Steve Lane, of South Florida Test Service, Miami, FL, and Nigel Cremer, C&W Specialist Equipment, Craven Arms, Shropshire, England

"Impedance Spectroscopy"—Richard D. Granata, Associate Director, Corrosion Laboratory, Lehigh University, Bethlehem, PA

• The Federation's Manufacturing Committee Seminar on "Manufacturing for Quality and Profitability in the Nineties" will offer the following:

"Integrating Safety and Quality to Improve Overall Operations"—Theodore C. Kughler, Jr., Manager of Quality, Chemicals and Pigments Department, E.I. du Pont de Nemours & Co., Inc., Wilmington, DE

"Quality—How It Can Add to Profitability"—Pat Donnally, Philip Crosby & Associates, San Jose, CA

"Effective Material Utilization to Improve Quality and Reduce Cost and Waste"—Charles Rooney, President, Orr & Boss, New York, NY.

• Scheduled papers to be presented on behalf of overseas organizations include:

"High Technology and Environmental Protection"—Paul Getenholm, of Scandinavian Paint and Printing Ink Research Institute, Horsholm, Denmark (presented on behalf of Scandinavian Paint and Varnish Technologists)

"Evaluation Method on Photodegradation of Paint Films by Using ESR Spectrometer"—Kiyoshi Hikita, Coatings Division, Nippon Oil & Fats Co. Ltd., Tokyo, Japan (presented on behalf of Japan Society of Colour Material)

Other scheduled program features include:

- Keynote Address
- Mattiello Lecture, "Learning to Leap: Rising to the Technical Challenge of Today's Coatings Industry," by Dr. Marco Wismer, formerly Vice President, Science and Technology, PPG Industries, Inc. (see April *JCT*).
- Roon Awards Competition papers.
- Constituent Society papers.

Serving with Mr. Pilcher on the Program Committee are: Vice-Chairman—Gary Gardner, Tnemec Co., Inc.; Adrian Adkins, Schoofs Inc.; Mary G. Brodie, The Sherwin-Williams Co.; David Graham, Lilly Industrial Coatings, Inc.; Richard M. Hille, General Paint & Chemical Co.; Richard J. Himics, Daniel Products Co.; Terryl Johnson, Cook Paint & Varnish Co.; and Percy E. Pierce, PPG Industries, Inc.

Paint Industries' Show

The Paint Industries' Show—the largest and best international exhibit of its kind in the world—will feature attractive exhibitor displays devoted to a wide variety of raw materials, production equipment, containers, laboratory apparatus, testing devices, and services furnished to the coatings manufacturing industry.

The purpose of the Show is to provide attendees with an opportunity to learn of

the latest developments in these products and services. Key personnel from the top technical and sales staffs of exhibitors will be on hand. More than 220 exhibitors from the U.S., Canada, and Europe, will utilize almost 74,000 net square feet of exhibit space at the Show. Exhibit hours will be 11:00-5:30 on Wednesday; 9:00-5:30 on Thursday; and 9:00-3:00 on Friday.

The Paint Show will be held at both the New Orleans Hilton's Exhibition Hall and at the adjacent Rivergate Exhibition Center.

Hotels and Reservations

Nine hotels in New Orleans have reserved blocks of rooms for the Annual Meeting and Paint Show. The Federation co-headquarters hotels will be the Marriott and the New Orleans Sheraton.

The other cooperating hotels are: Meridien, Monteleone, Omni Royale Orleans, Westin Canal Place, Doubletree, Holiday Inn Crowne Plaza, and the Hilton Riverside and Towers. The Monteleone and Omni Royale Orleans are located in the French Quarter. All hotel reservations will be processed by the Greater New Orleans Tourist and Convention Commission, which will accept only the official housing form furnished by the Federation.

Special Air Fares

Delta Air Lines, in cooperation with the FSCT, is offering a special discount fare which affords passengers a 40% minimum savings off their round trip, undiscounted day coach fares for travel to the FSCT Annual Meeting and Paint Industries' Show on the airlines' domestic systems. The discount from Canada is 35%.

To take advantage of this discount, you must: (1) Travel between November 4-14, 1989; (2) Purchase tickets at least seven days in advance; (3) Phone 1-800-241-6760 for reservations. Immediately reference the FSCT file number: **U0235.** The special fares are available only through this number.

Discounts are good for both direct and connecting flights to New Orleans. If you use a travel agent, have your reservations placed through the toll-free number to obtain the same fare advantages.

Spouses Activities

The Spouses Program of Activities will begin on Wednesday, November 8, with a get-acquainted wine and cheese social in the Mardi Gras Ballroom of the Marriott. On Thursday, there will be a deluxe motor coach tour of the city, featuring the French Quarter, the elegant Garden District, the shores of Lake Pontchartrain, the unique St. Louis III Cemetery, and a visit to Germaine Wells' Mardi Gras Museum. Lunch will be served during the tour at the famous Arnaud's Restaurant in the French Quarter. Spouses' registration also includes Continental Breakfast which will be served at the Marriott on Thursday and Friday mornings.

Host Committee

General co-chairmen of the 1989 Annual Meeting Host Committee are Thad Broome, of J.M. Huber Corp., and his wife Ginny. Assisting them are the following subcommittee chairmen: Information Services—Berger Justen, Justen & Associates; Program Operations—Bill Mehaffey, Mehaffey & Daigle, Inc.; Registration Area—Rick Rawle, Sunbelt Coatings, Inc.; Federation Exhibit—Dan Dixon, Engelhard Corp.; and Spouses' Program—Gerald Mattson, University of Southern Mississippi, and his wife Brenda.

NPCA to Meet Same Week

The National Paint and Coatings Association will hold its annual meeting on November 6-8, 1989, at the New Orleans Hilton. Persons wearing NPCA badges (who sign up at special registration desks at the Hilton and the Rivergate) will be admitted to the Paint Show on Wednesday only, with the compliments of the Federation.

Tinuvin® 1130: The only liquid benzotriazole UVA. Now water-based coatings can take their place in the sun.

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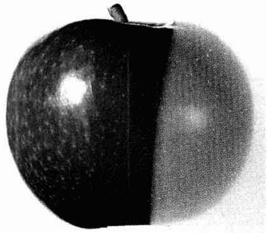
Water-based maintenance coatings formulated with Tinuvin 1130 have the best chance to meet the tough industry standards for durability and low VOC.



Left: Clear emulsion-based coating formulated with liquid Tinuvin 1130 UVA
Right: Clear emulsion-based coating formulated with a standard solid UVA

Versatile Tinuvin 1130 is also well-suited for high-solids thermosetting systems, such as automotive clear topcoats and waterborne base coats. It performs just as well in clear wood finishes and varnishes. And for even greater UV protection, Tinuvin 1130 works synergistically with Tinuvin 292 or Tinuvin 440 hindered amine light stabilizers.

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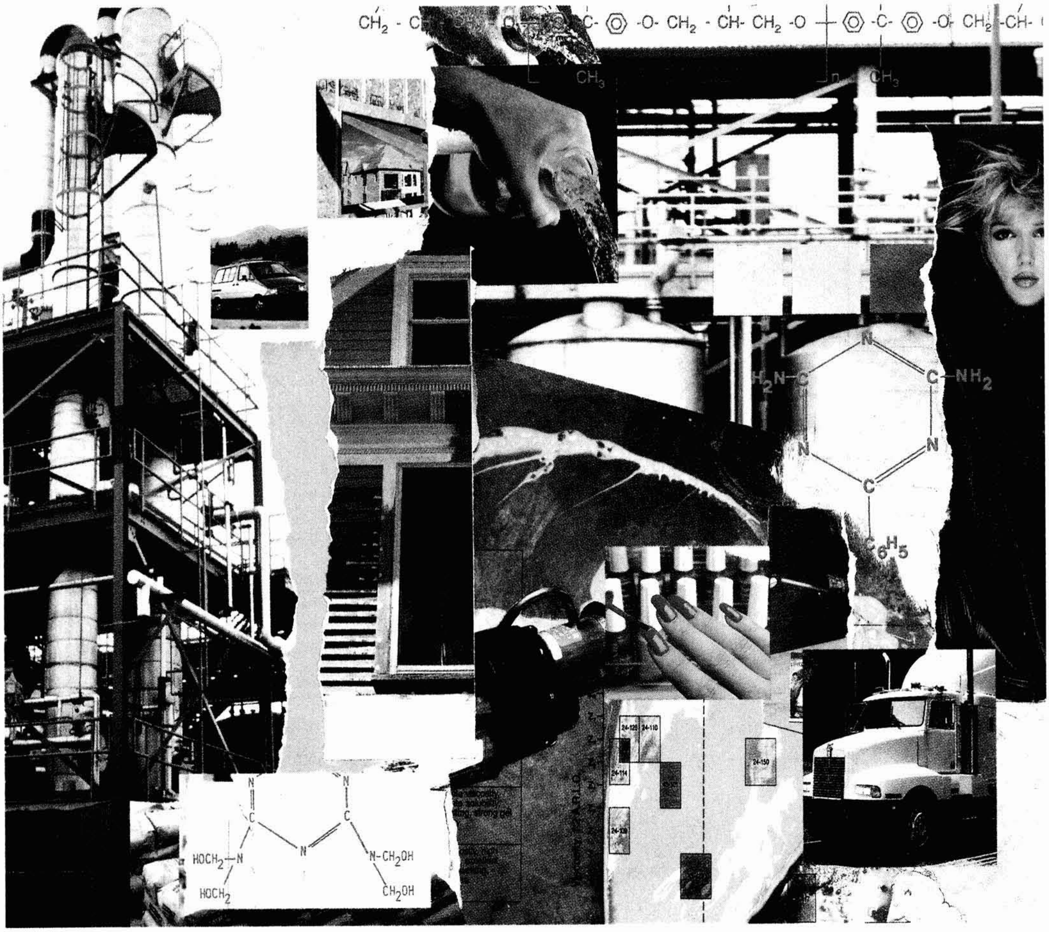
We're Reichhold—
world leaders in coating resins for over 60 years.



Since 1927, our products, such as Beckosol,® Beckamine,® Lustralite,® and Epotuf,® have been synonymous with the advancements in coatings technology. Together, let us continue this tradition by providing you with the products which will assure your success in the marketplace. Contact your local Reichhold sales representative or Bill Winters, Product Manager, Coating Resins, Coating Polymers and Resins Division of Reichhold Chemicals, Inc. **800/874-0868 or, in Florida, 800/342-3227.**

REICHHOLD

Regulatory UPDATE

JULY 1989

This digest of current regulatory activity pertinent to the coatings industry is published to inform readers of actions which could affect them and their firms, and is designed to provide sufficient data to enable those interested to seek additional information. Material is supplied by Roy F. Weston, Inc., Washington, D.C.

EPA Proposes Test Rule for 1,6-Hexamethylene Diisocyanate (HDI)—EPA is proposing a test rule under Toxic Substances Control Act (TSCA) Section 4 for 1,6-Hexamethylene Diisocyanate (HDI) that would require manufacturers and processors to test HDI for oncogenicity, mutagenicity, reproductive toxicity, developmental toxicity, neurotoxicity, pharmacokinetics, and hydrolysis. HDI is used in resins and trimers in polyurethane paint systems and EPA finds the greatest potential occupational exposure to HDI in coating application operations, specifically auto-body repair operations. See 54 Federal Register 21240 (May 17, 1989).

The proposed rule is in response to the Interagency Testing Committee's (ITC) designation of HDI for health effects consideration in its 22nd report. EPA is proposing that persons who manufacture and/or process, or who intend to manufacture and/or process HDI, other than as an impurity, at any time from the effective date of the final test rule to the end of the reimbursement period, be subject to the testing requirements in the proposed rule.

Comments are due in triplicate before July 17, 1989, to Docket No. OPTS-42107, TSCA Public Docket Office, (TS-793), Office of Pesticides and Toxic Substances, U.S. EPA, Room NE-G004, 401 M Street, S.W., Washington, D.C. 20460. If persons request an opportunity to submit oral comments by July 3, 1989, EPA will hold a public meeting on this rule in Washington, D.C. For further information, contact Michael M. Stahl, Director, TSCA Assistance Office, (TS-799), Office of Toxic Substances, Room EB-44, U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460, (202) 554-0551.

Food and Drug Administration (FDA) Considering Safe Use of Partial Sodium Salt of Ethylene-Acrylic Acid Copolymer—FDA is considering a petition filed by Muchelman, Inc., requesting regulations be amended to provide for the safe use of the partial sodium salt of ethylene-acrylic acid copolymer, used as an adhesive component in laminates that contact dry food. See 54 Federal Register 23540 (June 1, 1989).

For further information, contact Edward J. Machuga, Center for Food Safety and Applied Nutrition, (HFF-335), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

EPA Proposes to Exempt Copper Phthalocyanine Pigments from SARA Toxic Chemical Reporting and Requests Comments on Community Right-to-Know Delisting Process—EPA is proposing to exempt Pigment Blue 15, Pigment Green 7, and Pigment Green 36 under the "copper compounds" category from reporting requirements of Section 313 of the Superfund Amendments and Reauthorization Act of 1986 (SARA). See 54 Federal Register 20866 (May 15, 1989).

In addition, EPA is seeking comments on how to approach a number of issues relating to the chemical categories listed under Section 313. There are 20 listed categories in Section 313 and there are hundreds of chemicals within these categories. EPA is concerned about the resources and time that could be required if it continues its current approach to evaluating delisting petitions. It has proposed four options:

1) keep the 20 listed categories, respond to petitions to delete named chemicals from a category but give second priority to these petitions as compared to petitions to delist individually-listed chemicals;

2) subcategorize the listed categories by chemical structure;

3) independently evaluate the thousands of chemicals within the listed categories to determine if the chemicals meet the toxicity criteria of Section 313; or

4) keep the 20 listed catagories and consider delisting petitions only for individually-listed chemicals or for an entire listed category.

EPA would consider each listed category as an inseparable unit for this purpose.

Comments should be sent in triplicate by July 14, 1989, to OTS Docket Clerk, TSCA Public Docket Officer, U.S. EPA, Mail Stop TS-793, Room NE-G004, 401 M Street, S.W., Washington, D.C. 20460, Attn: Docket Control No. OPTS-400030. For further information, contact Robert Isreal, Acting Petition Coordinator, Emergency Planning and Community Right-to-Know Information Hotline, U.S. EPA, Mail Stop OS-120, 401 M Street, S.W., Washington, D.C. 20460, (800) 535-0202, or in Washington, D.C. or Alaska, (202) 479-2449.

Food and Drug Aministration (FDA) Allows Safe Use of Colorant for Polymers—The FDA, in granting a petition filed by CIBA-GEIGY Corporation, has changed its food additive regulations to allow for the safe use of 3,3[1]-[(2,5-dimethyl-1,4-phenylene)bis[imino(1-acetyl-2-oxo-2,1-ethanediyl)azo]]bis[4-chloro-N-(5-chloro-2-methylphenyl)-benzamide] as a colorant for polymers intended to contact food. See 54 Federal Register 21052 (May 16, 1989).

This amendment became effective May 16, 1989; written objections and requests for a hearing were due by June 15, 1989. For further information, contact Marvin D. Mack, Center for Food Safety and Applied Nutrition, (HFF-335), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

EPA Extends Comment Period on Advance Notice of Proposed Rulemaking (ANPRM) Considering Possibility of Listing Methyl Chloroform and Carbon Tetrachloride Under the Montreal Protocol—EPA announced in an ANPRM that it was considering the possibility of adding methyl chloroform (1,1,1-trichloroethane) and carbon tetrachloride to the list of ozone-depleting chemicals regulated under the Montreal Protocol on Substances that Deplete the Ozone Layer and the EPA rule implementing the Protocol. See 53 Federal Register 30566 (August 12, 1988). [See June 1989 FSCT *Regulatory Update* and also see 54 Federal Register 23495 (June 1, 1989)].

EPA extended the comment period on this ANPRM to July 1, 1989 with written comments to be sent to Docket (A-89-09), Air Docket, First Floor-Waterside Mall, Room 1500, LE131, U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460. For further information, contact Karla Perri, Division of Global Change, OAIAP, Office of Air and Radiation, (ANR-445), U.S. EPA, 401 M Street, S.W., Washington, D.C. 20460, (202) 475-7496

Occupational Safety and Health Administration (OSHA) Proposes New Exposure Standards for 4,4[1] Methylenedianiline (MDA)—OSHA proposed new standards for exposure to MDA, including reducing the eight-hour time-weighted average (TWA) to 10 parts per billion (ppb), and establishing a short-term exposure limit (STEL) to 100 ppb. See 54 Federal Register 20672 (May 12, 1989).

MDA is used in the production of elastomers, coatings, adhesives, sealants, pigments, and dyes, etc. The proposed rule also includes related provisions to reduce risk of exposure. For the most part, the provisions being proposed by OSHA were recommended by the MDA Mediated Rulemaking Advisory Committee (52 FR 26776).

Comments and requests for a hearing were due before June 26, 1989. For further information, contact James F. Foster, Director, Office of Public Affairs, OSHA, Room N-3641, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 523-8151.

EPA Proposes to Change Test Rule Requirements Under Toxic Substances Control Act (TSCA)—EPA is proposing to change TSCA regulations to change the treatment of certain small quantity manufacturers to that for processors under the current regulations. See 54 Federal Register 21238 (May 17, 1989).

The proposed rule would remove the requirement that certain small-quantity manufacturers file letters of intent to test and exemption applications at the early stage of a test rule, but still reserve the right to require compliance later, if necessary. The proposed rule would change the timing of submissions of study plans prior to initiation of testing.

Comments marked (OPTS-42052G) were due June 16, 1989. For further information, contact Michael M. Stahl, Director, TSCA Assistance Office, (TS-799), Office of Toxic Substances, Room EB-44, U.S. EPA, 401 M. Street, S.W., Washington, D.C. 20460, (202) 554-1404.

Occupational Safety and Health Administration (OSHA) Allows More Flexibility in Compliance Methods—OSHA is proposing more specific guidance detailing when respiratory protection can be used for worker exposure to toxics instead of controlling exposure via engineering controls. Requirements regarding short-term exposures for benzene (standards promulgated 52 FR 34460), formaldehyde (standards promulgated 52 FR 46168), and ethylene oxide (standards promulgated 53 FR 11414) may be changed as a result of this rulemaking. See 54 Federal Register 23991 (June 5, 1989).

OSHA's methods of compliance policy requires that employers use feasible engineering controls to prevent employee exposures from exceeding permissible levels, specifically for all exposures to airborne toxic substances and the 600 substances in Table 2. However, OSHA has set specific types of allowances and situations where engineering controls are not required and respirator use is permitted (e.g., standards for acrylometrile for maintenance and repair, and vessel cleaning). OSHA is seeking comment on whether these types of allowances should be incorporated into the general methods of compliance provisions.

Comments and requests for a hearing should be submitted by October 3, 1989, in quadruplicate to Tom Hall, OSHA, Division of Consumer Affairs, Docket No. H-160, Room N-3637, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210. For more information, contact James F. Foster, Office of Public Affairs, OSHA, Room N-3649, U.S. Department of Labor, 200 Constitution Avenue, N.W., Washington, D.C. 20210, (202) 523-8151.

EPA Proposes Significant New Use Rule (SNUR)—EPA, under Section 5(a)(2) of the Toxic Substances Control Act (TSCA), is proposing a SNUR for 1,3-Benzenediamine, 4(1,1-Dimethylethyl-ar-methyl. See 54 Federal Register 23226 (May 31, 1989).

Persons who intend to manufacture, import, or process this substance for a significant new use (e.g., other than what the previously-approved premanufacturing Notice specified) would be required to notify EPA at least 90 days in advance of such activity if EPA finalizes the SNUR.

Comments are due by July 31, 1989, in triplicate, to Document Processing Center, (TS-790), Docket No. OPTS-60572, Office of Toxic Substances, U.S. EPA, Room L-100, 401 M Street, S.W., Washington, D.C. 20460. For further information, contact Michael M. Stahl, Director, TSCA Assistance Office, (TS-799), Office of Toxic Substances, U.S. EPA, Room EB-44, 401 M Street, S.W., Washington, D.C. 20460, (202) 554-1404.

Food and Drug Administration (FDA) Considering Safe Use of Polyoxymethylene Copolymers and Homopolymers Stabilizer—FDA is considering a petition filed by CIBA-GEIGY Corporation to amend its food additive regulations to allow for safe increased use of ethylenebis (oxyethylene)-bis-(3-*tert*-butyl-4-hydroxy-5-methylhydrocinnamate as a stabilizer for polyoxymethylene copolymers and homopolymers intended for food-contact use. See 54 Federal Register 23268 (May 31, 1989).

For further information, contact Marvin D. Mack, Center for Food Safety and Applied Nutrition, (HFF-335), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

Food and Drug Administration (FDA) Considering Safe Use of Stabilizer for Polymer—FDA is considering a petition filed by CIBA-GEIGY Corporation proposing regulations be amended to allow for the safe use of 2-methyl-4,6-bis[(octylthio)methyl]phenol as a stabilizer for polymers used as adhesives, gaskets, cements, repeat-use rubber articles, and paper additives in contact with food. See 54 Federal Register 23540 (June 1, 1989).

For further information, contact Julius Smith, Center for Food Safety and Applied Nutrition, (HFF-335), Food and Drug Administration, 200 C Street, S.W., Washington, D.C. 20204, (202) 472-5690.

SUMMARY CALENDAR OF REGULATORY ACTIONS

June 15, 1989	Comments were due to FDA concerning requests for a hearing on use of colorant for polymers. (See this issue.)
June 16, 1989	Comments were due to EPA concerning treatment of certain small quantity manufacturers under TSCA. (See this issue.)
June 26, 1989	Comments were due to OSHA on new regulations governing exposure to MDA. (See this issue.)
July 1, 1989	Comments were due to EPA on ANPRM suggesting possibility of listing 1,1,1-trichloroethane and carbon tetrachloride under Montreal Protocol. (See this issue and June 1989 issue.)
July 1, 1989	Mandatory use of new EPA RCRA manifest form and OMB Burden Disclosure statement required. (See April 1989 issue.)
July 14, 1989	Comments due to EPA on proposed exemption of copper phthalocyanine pigments from toxic release reporting under SARA. (See this issue.)
July 17, 1989	Comments due to EPA on proposed test rule for 1,6-hexamethylene diisocyanate. (See this issue.)
July 31, 1989	Comments due to EPA on proposed Significant New Use Rule. (See this issue.)
October 3, 1989	Comments due to OSHA on increased use of respiratory protection for compliance with worker exposure. (See this issue.)
January 1, 1990	New Jersey limits on VOC content on architectural coatings effective. (See May 1989 issue.)
October 26, 1990	UST financial assurance requirements deadline for nonpetroleum companies with a net worth of less than $20 million. (See May 1989 issue.)

Federation of Societies for Coatings Technology

67th Annual Meeting ★ 54th Annual Paint Industries' Show

Housing and Advance Registration Forms

The New Orleans Hilton ★ The Rivergate

Wednesday, Thursday, Friday ★ November 8, 9, 10, 1989

New Orleans, Louisiana

67th Annual Meeting
54th Paint Industries' Show
November 8, 9, 10, 1989
The New Orleans Hilton and
The Rivergate
New Orleans, Louisiana

TO OUR MEMBERS AND FRIENDS OF THE FEDERATION EVERYWHERE:

It is a pleasure for me to invite all those associated with the coatings manufacturing industry to attend the Federation's 67th Annual Meeting and 54th Paint Industries' Show in "The Crescent City," New Orleans, November 8-10.

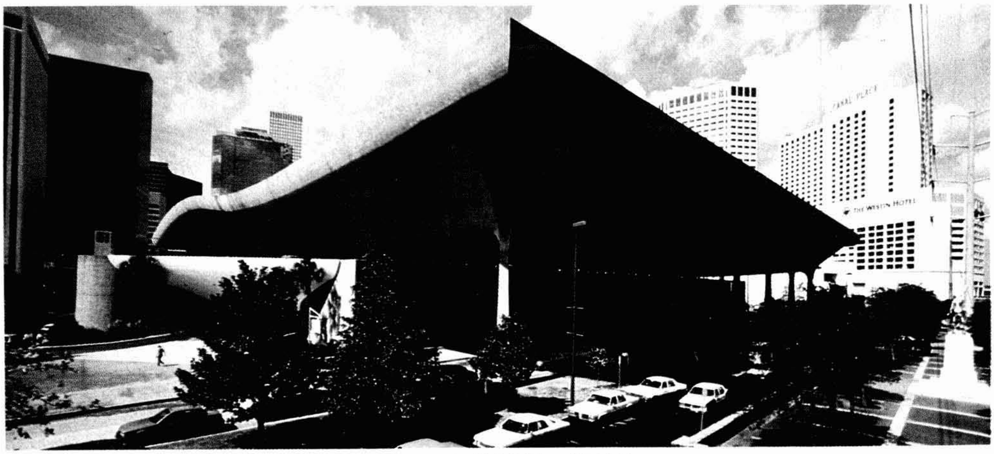
This year marks the initial visit of these popular Federation events to New Orleans. The Paint Industries' Show, coming off a record year in 1988, will be even bigger, with almost 74,000 net square feet of exhibit space at the New Orleans Hilton Exhibition Hall and at the adjacent Rivergate Exhibition Center.

Running concurrently with the Paint Show will be the technical Program Sessions with the theme – "Coatings Worldwide: Meeting the Needs of the Nineties." Presentations will focus on the increasingly international aspects of the coatings industry and the technology required for future progress.

The locals call it "The Big Easy"; everyone else calls it "Fun." To the Coatings Industry in 1989, New Orleans means the largest and finest exhibition of materials, equipment, and services in the world – and – programming to help you to better prepare for the future.

James E. Geiger

James E. Geiger
President, FSCT



Rivergate Exhibition Center

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
1989 ANNUAL MEETING AND PAINT INDUSTRIES' SHOW
THE NEW ORLEANS HILTON AND THE RIVERGATE
WEDNESDAY, THURSDAY, AND FRIDAY, NOVEMBER 8, 9, 10, 1989

The combined Annual Meeting and Paint Industries' Show is a major educational activity of the Federation. This international coatings manufacturing industry event consists of three days of technical program sessions and exhibits, running concurrently. Registration is required for admission.

"COATINGS WORLDWIDE: MEETING THE NEEDS OF THE NINETIES"

The theme of the 1989 Annual Meeting underscores the coatings industry's heightened awareness that it is part of a global marketplace, and that all areas of interest and endeavor are being viewed from an increasingly international perspective. Programming will focus on such areas pertinent to the "Decade of the Nineties" as raw material availability, uses of computers, environmental regulations, new approaches for corrosion control, manufacturing for excellence, and advanced topics on the "cutting edge" of the industry.

Also on the program will be the Mattiello Memorial Lecture, Roon Award Papers, Society Papers, and Seminars. Speakers will come from throughout the world of coatings science and manufacture.

ANOTHER RECORD PAINT SHOW WILL FEATURE LATEST PRODUCTS/SERVICES OF MORE THAN 220 EXHIBITORS

The Paint Industries' Show — the largest and best international exhibit of its kind in the world — will feature attractive exhibitor displays devoted to a wide variety of raw materials, production equipment, containers, laboratory apparatus, testing devices, and services furnished to the coatings manufacturing industry.

The purpose of the Show is to provide attendees with an opportunity to learn of the latest developments in these products and services. Key personnel from the top technical and sales staffs of exhibitors will be on hand. More than 220 exhibitors from the U.S., Canada, and Europe, will utilize almost 74,000 net square feet of exhibit space at the Show. Exhibit hours will be 11:00 - 5:30 on Wednesday; 9:00 - 5:30 on Thursday; and 9:00 - 3:00 on Friday.

The Paint Show will be held at both the New Orleans Hilton's Exhibition Hall and at the adjacent Rivergate Exhibition Center.

HOTELS/RESERVATIONS: MARRIOTT AND SHERATON CO-HEADQUARTERS

Nine hotels in New Orleans have reserved blocks of rooms for the Annual Meeting and Paint Show. The Marriott and Sheraton will be the co-headquarters hotels.

The other cooperating hotels are: Meridien, Monteleone, Omni Royal Orleans, Westin Canal Place, Doubletree, Holiday Inn Crowne Plaza, and the Hilton. The Monteleone and Omni Royal Orleans are located in the French Quarter.

Rooms are subject to an 11% occupancy tax plus a $2.00 per room night city ordinance tax. All hotel reservations will be processed by the FSCT Housing Bureau. Phone reservations will not be accepted. You will receive an acknowledgment of your reservation from the Housing Bureau. This is not the hotel confirmation; that will be sent to you directly from the hotel to which you have been assigned.

Reservations for the Hilton will be accepted for arrival beginning Wednesday, November 8, only. Any reservations requesting the Hilton for arrival prior to November 8 will be assigned to another hotel.

Requests for accommodations at either the Marriott or Sheraton will be limited to ten rooms per company. A parlor counts as one room. All hotels require deposits. Please mail your deposit directly to the hotel. Additions, changes, and cancellations must be submitted in writing directly to the hotel in which you have been confirmed. (All hotels are in New Orleans, LA — zip codes in parens.)

Marriott
Canal & Chartres Sts. (70140)

Sheraton
500 Canal St. (70130)

Meridien
614 Canal St. (70130)

Monteleone
214 Rue Royale (70140)

Omni Royal Orleans
621 St. Louis St. (70140)

Westin Canal Place
100 Rue Iberville (70130)

Doubletree
300 Canal St. (70140)

Holiday Inn Crowne Plaza
333 Poydras St. (70130)

Hilton
Poydras at the Mississippi River (70140)

HOTEL ROOM AND SUITE RATES

Map No.	Hotel	Singles	Doubles/Twins	Suites 1 BR	Suites 2 BR
1	Marriott	$112	$128	$360-400	$488-528
2	Sheraton	115	130	183-310-480	310-705
	Towers	135	170	480-600	705
3	Meridien	95	105	275 & up	500 & up
4	Monteleone	92	104	215-425	325-550
5	Omni Royal Orleans	99,140,165	160,185	310,350	475,515
6	Westin Canal Place	115	130	350-425	525-600
7	*Doubletree*	85	95	160-200	300-400
8	Holiday Inn Crowne Plaza	95	110	226-446	349-592
9*	New Orleans Hilton	115	135	290-950	375-1125
	Towers	165	185	575-950	725-1100

Note: Rates subject to 11% occupancy tax plus a $2.00 per room night city ordinance tax.
All hotels require a first-night room deposit. Please send directly to hotel.
*Reservations at the Hilton will be accepted for arrival beginning Wednesday, November 8, only.

(1) Marriott
Canal & Chartres Sts. (70140)

(2) Sheraton
500 Canal St. (70130)

(3) Meridien
614 Canal St. (70130)

(4) Monteleone
214 Rue Royale (70140)

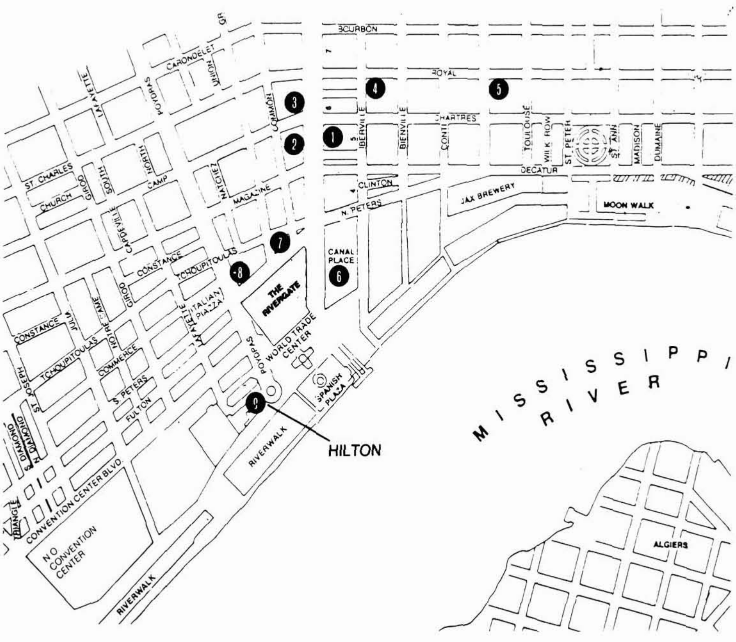
(5) Omni Royal Orleans
621 St. Louis St. (70140)

(6) Westin Canal Place
100 Rue Iberville (70130)

(7) Doubletree
300 Canal St. (70140)

(8) Holiday Inn Crowne Plaza
333 Poydras St. (70130)

(9) New Orleans Hilton
Poydras at the Mississippi River (70140)



1989 FSCT ANNUAL MEETING AND PAINT INDUSTRIES' SHOW
NEW ORLEANS HILTON AND RIVERGATE, NEW ORLEANS, LA
WEDNESDAY, THURSDAY, AND FRIDAY, NOVEMBER 8, 9, 10

67th Annual Meeting & 54th Paint Industries Show
FSCT 1989

APPLICATION FOR HOTEL ACCOMMODATIONS

Mail to: **FSCT Housing Bureau**
1520 Sugar Bowl Dr.
By 10/5/89 **New Orleans, LA 70112**

Please indicate below the type of accommodations desired and the choice of hotels. (Refer to the hotel map and rates on opposite page.) All reservations will be processed by the FSCT Housing Bureau. Hotel assignments will be made in accordance with the prevailing availability. You will receive an acknowledgment of your reservation from the Housing Bureau. This is not the hotel confirmation. That will come to you directly from the hotel to which you have been assigned. *Changes/additions/cancellations must be submitted in writing to the hotel.*

TYPE OF ACCOMMODATION	NUMBER	RATE REQUESTED
Single (1 person)		
Double (2 persons)		
Twin (2 persons)		
Suite (parlor and 1 bedroom)		
Suite (parlor and 2 bedrooms)		

CHOICE OF HOTELS
1ST
2ND
3RD
4TH

NAMES OF ROOM OCCUPANTS AND DATES OF ARRIVAL/DEPARTURE

Type of Room	**Name**	**Dates** Arrive	Depart

Please Type Additional Reservations on a Separate Sheet and Attach to This Form

SEND CONFIRMATION FOR ALL RESERVATIONS TO:

Name ______________________ Telephone ______________

Company ______________________ FAX ______________

Address ______________________

City, State, Zip ______________________

Country ______________________

Name of Credit Card ______________ Signature ______________

Credit Card Number ______________ Exp. Date ______________

Note: (1) Requests for accommodations at either the Marriott or the Sheraton will be limited to 10 rooms per company.
(2) Reservations for the Hilton will be accepted for arrival beginning Wednesday, November 8, only.

SPECIAL FARES AVAILABLE FROM DELTA AIR LINES

Delta Air Lines, in cooperation with the FSCT, is offering a special discount fare which affords passengers a 40% minimum savings off their round trip, undiscounted day coach fares for travel to the FSCT Annual Meeting and Paint Industries' Show on the airlines' domestic systems. The discount from Canada is 35%.

To take advantage of this discount, you must: (1) Travel between November 4-14, 1989; (2) Purchase tickets at least seven days in advance; (3) Phone 1-800-241-6760 for reservations. Immediately reference the FSCT file number: U0235. The special fares are available only through this number.

Discounts are good for both direct and connecting flights to New Orleans. If you use a travel agent, have your reservations placed through the toll-free number to obtain the same fare advantages. Delta has a variety of other promotional fares, some of which may represent even greater savings. When you phone for reservations, ask for the best discount applicable to your itinerary.

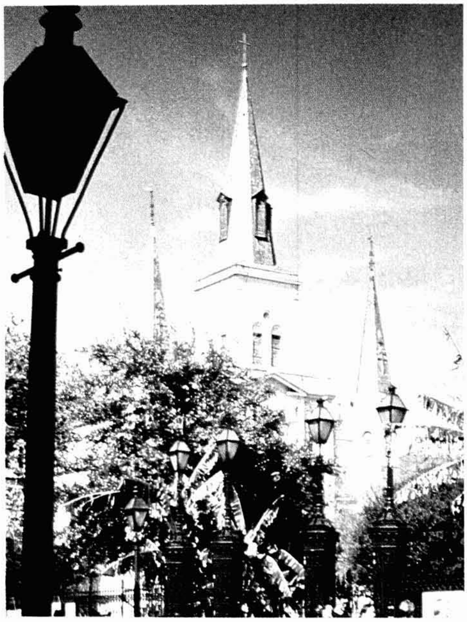
FEDERATION BOARD OF DIRECTORS TO MEET ON TUESDAY AT MARRIOTT

The Board of Directors of the Federation will meet on Tuesday, November 7, at 9:00 a.m. in the Marriott.

HILTON EXHIBITS – SITE OF DELTA FIRST-CLASS TICKETS DRAWING

The Federation will offer a special door prize during the Paint Show: a pair of Delta Air Lines first-class, round-trip tickets for any destination in the continental United States. Entries must be made at a special location at the Hilton Exhibition Hall. The drawing will be held at the Hilton Exhibition Hall at 11:00 a.m., Friday, November 10. Winner need not be present, however, the announcement of the winning entry will be made at the Federation's Annual Luncheon.

Hilton Riverside and Towers Hotel



St. Louis Cathedral, Jackson Square

FEDERATION ANNUAL LUNCHEON WILL BE HELD ON FRIDAY

The annual Federation Luncheon will be held on Friday, November 10, at the New Orleans Hilton.

SPOUSES PROGRAM INCLUDES TOUR OF FRENCH QUARTER

The Spouses Program will open on Wednesday with a get-acquainted wine and cheese social in the Mardi Gras Ballroom of the Marriott Hotel. On Thursday, there will be a deluxe motor coach tour of the city, featuring the French Quarter, the elegant Garden District, the shores of Lake Pontchartrain, the unique St. Louis III Cemetery, and a visit to Germaine Wells' Mardi Gras Museum. Lunch will be served during the tour at the famous Arnaud's Restaurant in the French Quarter. Also included in the spouses' registration is Continental Breakfast served at the Marriott on Thursday and Friday mornings.

NPCA TO MEET SAME WEEK AT NEW ORLEANS HILTON

The National Paint and Coatings Association will hold its annual meeting on November 6-8, 1989, at the New Orleans Hilton Riverside and Towers. Persons wearing NPCA badges (who sign up at a special registration desk at the Hilton) will be admitted to the Paint Show on Wednesday only, with the compliments of the Federation.

1989 Advance Registration

FEDERATION OF SOCIETIES FOR COATINGS TECHNOLOGY
1315 Walnut St., Philadelphia, PA 19107

C	Office Use Only
U	Date Received ____
	Amount $ ____
V	Check No. ____

Please fill out this form and mail with a check in the correct amount (made payable to the FSCT) **to the Federation address shown above.** All checks must be payable in U.S. Funds. Any that are not will be returned. DEADLINE DATE FOR ADVANCE REGISTRATION IS OCTOBER 13. NONE WILL BE ACCEPTED AFTER THAT DATE.

A $10.00 charge will be made for cancellations received prior to October 13. No refunds will be made after that date.

INDUSTRY REGISTRATION FEES:

A ☐ **MEMBER** **$60.00**

Please name the Federation Society in which you are a paid-up member:

____
Federation Constituent Society

B ☐ **NON-MEMBER** **$75.00**

G ☐ **SPECIAL FEE FOR RETIRED MEMBERS** **$25.00**

____
Federation Constituent Society

INFORMATION FOR REGISTRATION BADGE:

NICKNAME ☐☐☐☐☐☐☐☐☐☐

FIRST NAME LAST NAME ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

COMPANY ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

STREET ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

CITY ☐☐☐☐☐☐☐☐☐☐☐☐☐☐ STATE *(U.S. only)* ☐☐ POSTAL CODE ☐☐☐☐☐☐☐☐☐☐

COUNTRY *(OTHER THAN U.S.)* ☐☐☐☐☐☐☐☐☐☐ TELEPHONE NO. ☐☐☐☐☐☐☐☐☐☐

BUSINESS CLASSIFICATION DATA FOR THE ABOVE REGISTRANT:

YOUR COMPANY (CHECK ONE BLOCK)

- AA ☐ Manufacturers of Paints, Varnishes, Lacquers, Printing Inks, Sealants
- BB ☐ Manufacturers of Raw Materials
- CC ☐ Manufacturers of Equipment and Containers
- DD ☐ Sales Agent for Raw Materials + Equipment
- EE ☐ Government Agency
- FF ☐ Research/Testing/Consulting
- GG ☐ Educational Institution Library
- HH ☐ Paint Consumer
- JJ ☐ Other

YOUR POSITION (CHECK ONE BLOCK)

- KK ☐ Management/Administration
- LL ☐ Manufacturing and Engineering
- MM ☐ Quality Control
- NN ☐ Research and Development
- PP ☐ Technical Sales Service
- QQ ☐ Sales and Marketing
- RR ☐ Consultant
- SS ☐ Educator/Student/Librarian
- TT ☐ Other

SPOUSES REGISTRATION AND INFORMATION FOR REGISTRATION BADGE:

D ☐ **SPOUSE** **$40.00**

NICKNAME ☐☐☐☐☐☐☐☐☐☐

FIRST NAME LAST NAME ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

SPECIAL FEE FOR THE SPOUSES OF RETIRED MEMBERS ONLY:

CITY ☐☐☐☐☐☐☐☐☐☐☐☐☐☐ STATE *(U.S. only)* ☐☐ POSTAL CODE ☐☐☐☐☐☐☐☐☐☐

H ☐ **$25.00**

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NPCA's Community Service Campaign Underway; Anti-Graffiti Program Receives Silver Anvil Award

The month of May, designated National Paint Month, signaled the official kickoff of the 1989 "Picture It Painted" (PIP) community service campaign. The goal of PIP, sponsored by the National Paint & Coatings Association (NPCA), Washington, D.C., is to bring a colorful makeover to community buildings nationwide through the efforts of NPCA affiliates.

Since the inception of PIP in 1980, local paint and coatings associations have been donating paint, labor, and design expertise to renew facilities, from low-income homes to inner-city schools to historic landmarks.

To date, the 1989 PIP list consists of 50 painting projects including: the restoration of a historic carousel house in Queens, New York; the establishment of a paint bank for anti-graffiti projects in the Golden Gate area; an interior mural project at a center for abused children in Kansas City; and a wealth of support for Habitat for Humanity, a national program dedicated to the construction and rehabilitation of low-income homes.

Multiple projects are being sponsored by a number of locals. The Puget Sound Paint and Coatings Association is sponsoring two separate graffiti cleanup projects, supplying paint for murals throughout Seattle, repainting a historic light ship, and working to renew homes in Spokane and Seattle. The Cleveland group has planned a diverse lineup, donating paint to support a camp for handicapped children, a home for unwed mothers, and a neighborhood program called "Stride for Pride."

May was the start of the PIP season, but projects will be sponsored throughout the summer and climax in early September with the Allen W. Clark Award competition. The Clark Award recognizes one or more local associations for an outstanding community service campaign.

This year, in addition to the Puget Sound Paint and Coatings Association, many of the local associations are undertaking anti-graffiti projects as part of their community service campaign. The projects are in support of NPCA's efforts to combat the passage of spray paint lock-up legislation.

This NPCA project to help cities deal with the problem of graffiti has been recognized with a Silver Anvil Award by the Public Relations Society of America.

The program, a three-year effort sponsored and funded by NPCA's Spray Paint Manufacturers Committee, is designed to help solve graffiti problems by focusing public attention on the criminal aspects of graffiti vandalism, rather than on spray paint.

NPCA recognized that anti-graffiti sentiment was growing in states and communities nationwide, and that most of the legislation being passed or considered was directed toward restricting the product rather than tougher enforcement of anti-vandalism laws. The program's sponsors developed a two-part strategy: first, to redirect attention to perpetrators; and second, to position the spray paint industry as a resource and helper in dealing with the whole problem—prevention, education, law enforcement, and cleanup.

NPCA's affiliated local associations have also lent support to the program, with members providing products and labor for numerous cleanups across the nation.

NPCA's anti-graffiti efforts were recognized by the Reagan Administration in late 1988 when they received the Take Pride in America Award.

1988 Coil Coaters Survey Indicates Drop In North American Use of Coil Coating

An annual survey conducted by the National Coil Coaters Association (NCCA), Philadelphia, PA, has detected that coil coating in North America dropped an estimated 2.4% during 1988.

The quarterly study also discovered that the use of weldable zinc-rich primer in the automotive industry plunged 30.7% from 1987 levels to what many in the industry feel is now the "bottom" of the cycle.

At the same time, the use of precoated steel in building products rose 20.2%, in appliances it rose 14.5%, and in the emerging market of furniture, fixtures, and equipment, it rose 3.9%.

The aluminum-using industries for coil coating consumed a record 846 tons in 1988, which exceeds the old record of 841 tons established in 1978.

The container and packaging industry continues to lead the traditionally largest market, building products, for the second year in a row.

The NCCA surveys all North American coil coaters each quarter for shipment data, including end-use market breakdown of shipments. The total industry shipments are estimated for nonreporting coil coaters and these projections are then submitted to several steel and aluminum producers for verification.

Akzo NV Agrees to Purchase Two U.S. Companies

Akzo NV of The Netherlands has announced an agreement to acquire Reliance Universal, Inc., a subsidiary of Tyler Corporation, for $275 million. Reliance Universal is a producer of specialty industrial and furniture coatings and polymers.

Reliance has over 1,500 employees at 15 different locations in the U.S., two locations in Canada, and one location in Belgium. The company reported sales in fiscal year 1988 of $289 million.

The transaction is undergoing due diligence review, upon approval by Tyler shareholders and normal antitrust clearances.

In other news, Akzo has reached an agreement in principle with KaiserTech Limited, Oakland, CA, to purchase its subsidiary Filtrol Corporation.

Filtrol, a producer of fluid cracking catalysts for the petroleum refining industry, is located in Vernon, a suburb of Los Angeles, CA. The company has 300 employees.

Air Products Initiates Plan For Polyvinyl Alcohol Plant

Air Products and Chemicals, Inc., Allentown, PA, has begun design engineering for a new 70 million-pound-per-year polyvinyl alcohol plant.

The company plans to build the new facility along the U.S. Gulf Coast. Construction of the plant, which will complement Air Products' existing 115 million-pound-per-year polyvinyl plant in Calvert City, KY, is expected to begin early next year. The startup date is targeted for 18 months later.

The project will incorporate new proprietary process technology.

CAS Survey Indicates U.S. and Japan Account For 45% of Scientific Publications Abstracted

The American Chemical Society's Chemical Abstracts Service (CAS), Columbus, OH, has disclosed that Japanese scientific papers and patents accounted for almost 20% of the 475,545 publications they have abstracted and indexed.

U.S. papers and patents made up approximately 25% of the total while the Soviet Union, ranked third, accounted for 12% of the total.

Scientific papers abstracted by CAS in 1988 originated in 150 countries. Patents issued by 29 patent offices were abstracted during the year.

According to CAS, U.S. chemical research and development continues to produce the most journal literature (27.4% of the 389,685 journal articles, dissertations, conference papers, and technical reports abstracted in 1988, reported work performed in the U.S.). Other major sources of chemical papers in 1988 were the Soviet Union (13%), Japan (11.5%), the Federal Republic of Germany (6.3%), and the United Kingdom (5.6%). The People's Republic of China now accounts for 3.5% of the journal literature abstracted by CAS, up from less than 1% eight years ago.

Scientific papers abstracted in 1988 were published in 46 different languages. English is the predominant language accounting for more than 73% of the papers abstracted by CAS in 1988, followed by Russian 12%, Japanese 4%, German 3.3%, and Chinese 2.8%.

Almost 54% of the 80,795 chemical patent documents CAS abstracted in 1988 came from the Japanese Patent Office. The European Patent Office was second with 10.3%, and the U.S. was third with 6.9%.

Of the five broad subdisciplines under which CAS classifies abstracts for publication, biochemistry produced 34.3% of the literature in 1988. It was followed by physical-inorganic-analytical chemistry 27.9%, applied chemistry and chemical engineering 21.3%, macromolecular chemistry 9%, and organic chemistry 7.5%.

CAS recorded 551,212 new chemical substances reported in the scientific literature during 1988 in its computer-based Chemical Registry. Another 51,253 substances were added to the CAS Registry during the year as part of a project to register substances indexed by CAS prior to 1962. The CAS Registry contains information on 9.3 million unique substances.

CAS has abstracted and indexed all new information on chemistry and chemical engineering published around the world since 1907.

A 1988 annual report and statistical summary are available on request from the Chemical Abstracts Service Planning and Communications Dept., 2540 Olentangy River Rd., P.O. Box 3012, Columbus, OH 43210.

Baxenden Limited Purchases Vinalak Line of Polymers

The Specialty Chemicals Division of Baxenden Chemicals Limited has acquired the Vinalak line of solution polymers from Vinamul Limited, a subsidiary of Unilever.

Baxenden has worked closely with Vinamul for the past five years in the manufacture and quality control of the acquired products. The purchase is timed to coincide with Baxenden's capacity increase for both acrylic and polyurethane production. The Vinalak polymers, renamed Xenalak, are used mainly in the manufacture of specialty coatings and surface treatments.

Baxenden, with headquarters in Baxenden, England, is a majority-owned subsidiary of Witco Corporation, New York, NY.

Discount Pricing Policy Offered by Bohlin Reologi

Bohlin Reologi, Inc., Edison, NJ, a manufacturer of sophisticated rheological instrumentation, is offering a discount pricing policy for universities and nonprofit organizations.

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For further information, write Bohlin Reologi, Inc., 11 Harts Lane, Suite G, East Brunswick, NJ 08816.

Hercules to Acquire Assets Of The Aqualon Group

Hercules Incorporated, Wilmington, DE, has announced the signing of a memorandum of intent under which they will purchase 50% interest in The Aqualon Group now owned by Henkel KGaA, Dusseldorf, Federal Republic of Germany.

Under the terms of the agreement, Hercules will acquire all of the global assets and business of Aqualon, a producer of water-soluble polymers. Henkel will retain certain assets for production of methycellulose in Germany, but will toll-produce a portion of Aqualon's requirements on an exclusive basis. Aqualon will continue to produce methylcellulose at its Doel, Belgium plant.

Closing of the transaction is expected pending approval of government regulatory bodies. Terms of the transaction are subject to approval of both Boards of Directors.

The Aqualon Group was formed as a joint venture of Henkel and Hercules in 1987 and operated as a stand-alone, independent company. Aqualon sales totalled approximately $350 million in 1988, up 15% from the previous year.

First Phase of Expansion To Begin at Goodyear Plant

The Goodyear Company, Houston, TX, will begin the first phase of a proposed $31.5 million, three-phase expansion program at its Houston synthetic rubber plant.

The approved $9 million first phase, which is designed to increase the production capacity for nitrile butadiene rubber and latex products by 25%, is scheduled for start-up in July 1990.

The proposed second and third phases of the expansion call for an additional $22.5 million investment in facilities, equipment modernization, and new finishing lines.

This expansion is in addition to Goodyear's announced $6 million addition of a powdered nitrile rubber unit, at the same facility, for thermoplastic elastomer applications.

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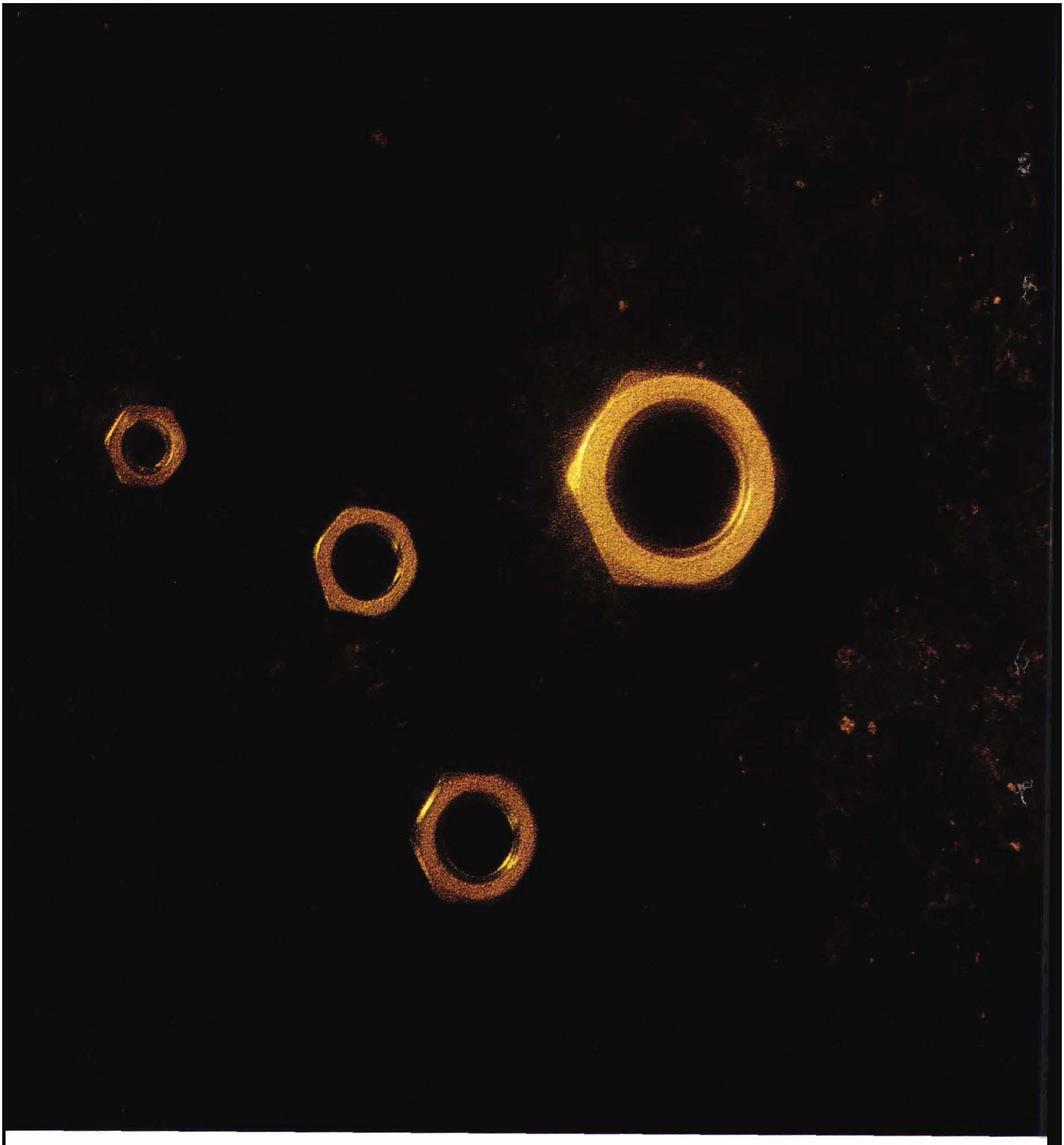

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Evaluation of Corrosion Protection Methods for Magnesium

F. Mansfeld, S. Kim, and S. Lin
University of Southern California*

The corrosion behavior of chrome-manganese conversion coated or anodized Mg AZ31 with an epoxy coating has been evaluated by electrochemical impedance spectroscopy (EIS) during exposure to 0.5 N NaCl. Samples coated with this commercial procedure survived exposure to 0.5 N NaCl for two months without pitting. The corrosion protection of coated Mg can be well characterized by using EIS.

INTRODUCTION

The benefits of magnesium alloys, such as high strength-to-weight ratio, excellent machineability, and good casting qualities present possibilities to replace aluminum parts with magnesium alloys in the aerospace and automobile industries. However, the poor corrosion resistance of magnesium limits its use without protective coatings. A number of methods are used to provide a barrier layer which is resistant to corrosive environments. A proper chemical surface preparation is essential for removing the air-formed alkaline hydroxide-carbonate layer on the magnesium surface before conversion of this corrosion susceptible surface into a corrosion resistant and less alkaline surface. Chromate conversion coatings or anodizing procedures such as Dow #17 or HAE have been used for corrosion protection of magnesium. These treatments also provide better adhesion of epoxy or other polymer coatings.

Various chromating treatments are in use throughout the world. The chrome-manganese process is one of the conversion processes and is described in the British specification, DTD 911C. The chemical conversion bath consists of sodium dichromate, manganese sulfate, and magnesium sulfate. The chrome-manganese film provides limited protection against normal atmospheric corrosion, but makes a good paint base. The applied film is self-healing, since soluble chromate ions are able to cover small scratches in the film. Baking renders the film less soluble in water.[1]

Excellent paint-base or polymer coating-base qualities and reasonable corrosion resistance are the characteristics of anodizing. It also has good hardness and abrasion resistance. The process uses either an aqueous acidic electrolyte containing a combination of phosphate, fluoride, and chromate ions (Dow #17) or an aqueous alkaline electrolyte containing a combination of phosphate, fluoride, manganate, and aluminum ions (HAE). Each process provides two general thicknesses of the coating. The hard, thick anodized surface is very porous and provides a good base for polymer coatings with good adhesion.

Surface sealing based on organic materials is a subsequent process for corrosion protection in aggressive environments. Various organic resins and inhibiting pigments are used for surface sealing. Sealing of pores in chemically prepared layers may provide the maximum corrosion resistance. The epoxy coating used in this study is specified in the British regulation DTD 5562 and consists of three coating layers. It performs very well on surfaces treated by chromate or anodizing processes.

EXPERIMENTAL APPROACH AND RESULTS

Corrosion protection and corrosion processes due to damage of the coating layer are well characterized by electrochemical impedance spectroscopy (EIS). Mansfeld, et al.,[2] have described an approach for collection of EIS data under optimized conditions. The equipment set-up is illustrated in *Figure* 1. The important aspects of this

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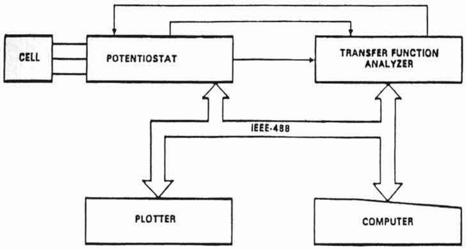

Figure 1—Experimental arrangement for recording of EIS-data

approach are the computer-controlled selection of the current amplifier in the potentiostat and a reduction of the measuring time at frequencies below 1 Hz. To minimize the phase shift at high frequencies, which is caused by the saturated calomel electrode, a pseudo-reference electrode is used in the form of a capacitatively coupled platinum wire.[3] Due to the very high impedance values at low frequencies, which were above 10^7 ohm for good coating systems, it was necessary to use an ac signal of 100 mV. The EIS measurements were carried out with a Solarton model 1250 Frequency Response Analyzer (FRA) and a model 1286 potentiostat.

The Mg AZ31 specimen were pretreated by either the Cr-Mn conversion process or anodizing (HAE or Dow #17) followed by one, two, or three coating layers which were applied by dipping in epoxy resin and baking in an oven after each dipping. All processes were done commercially by Magnesium Elektron Ltd. (MEL).

SEM analyses of cross sections showed that the thickness of the coating was 2, 20, and 70 μm for the Cr-Mn conversion coatings, Dow #17, and HAE, respectively. Discontinuous layers in the Cr-Mn conversion coating and pores in the anodized coating were sealed by the epoxy coating, as shown in *Figure* 2. The thickness of the first epoxy layer was 4 μm on the Cr-Mn coated surface. The thickness of the coatings did not increase on the anodized surfaces which absorbed most of the epoxy resin to seal the pores. Subsequent dipping into the resin increased the coating thickness and reached 16 and 20 μm after three dippings for the Cr-Mn coating and the anodized surface, respectively. Some larger sized pores in the anodized layer near the magnesium surface were not sealed even after being dipped three times in epoxy. This may be caused by the faster curing epoxy resin which offers less flexibility[4] than other epoxy resins, which seal pores more effectively.[5]

Dow #17

The corrosion resistance of anodized (Dow #17) Mg AZ31 coated with one to three layers of the epoxy coating and that of bare Mg are compared in *Figure* 3, which shows the impedance spectra determined during exposure in 0.5 N NaCl. The curve for the bare Mg (curve "Mg,1") is characteristic for the pitting process, where an inductive response occurs at low frequencies. Application of the Dow #17 anodizing process with water glass sealing provided some corrosion protection and the spectra shown in *Figure* 3 for five days exposure (curve "OL,5") did not change until pitting occurred after 26 days exposure (curve "26" *Figure* 4). The improvement of the corrosion resistance by dipping in epoxy resin is evident by the large increase of the impedance at low frequencies in the spectra measured after seven or eight days exposure (*Figure* 3). The relative small increase of the impedance after application of one epoxy layer (curve "1L") and the very large decrease of the capacitance and the increase of the resistance at low frequencies after application of two (curve "2L") or three (curve "3L") epoxy layers suggest that the first layer fills the pores of

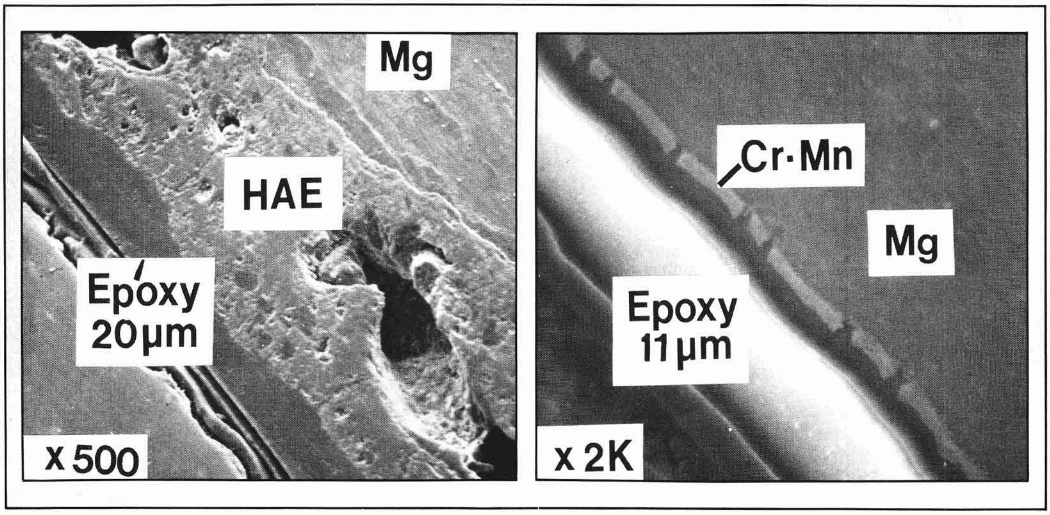

Figure 2—SEM micrographs of three layers of epoxy on anodized (HAE) Mg and two layers of epoxy on conversion coated (Cr-Mn) Mg

the oxide, while more dipping builds up an epoxy layer which covers the whole surface. Two and three epoxy layers provide excellent corrosion protection in aerated 0.5 N NaCl. From the capacitance calculated from the high frequency data, one can estimate that the thickness of coating layers may be about 21 and 12 μm for three and two epoxy layers, respectively, based on a dielectric constant of 3.63.

The corrosion behavior of anodized (Dow #17) Mg AZ31 with water glass sealing was measured for one month (*Figure* 4). Curve "0" shows the impedance data after exposure for two hours. After one day exposure (curve "1"), the water glass sealed anodized surface was attacked by the 0.5 N NaCl solution as indicated by the decrease of the impedance in the entire frequency range. While impedance spectra changed significantly during the first five days, these changes were less significant for the remaining three weeks (curves "5" and "26") until the end of the measurement, when pitting was observed as one small black deposit on the surface.

One epoxy layer produced better corrosion protection than water glass sealing as can be seen by the high dc limit of the impedance of over 10^7 ohm ($2 \cdot 10^8$ ohm·cm^2) and the low capacitance of 0.1 nF/cm^2 after two hours exposure (curve "0" *Figure* 5). These values changed greatly during two days exposure and additional resistive response appeared at high frequencies which may have been caused by pores in the coating layer.[2] The capacitance of the coating layer appeared at higher frequencies than the maximum frequency limit of 65 KHz of the FRA. The impedance spectra became characteristic for the pitting process after 37 days, when an inductive response occurred at low frequencies. Pitting was observed visually as the appearance of one black deposit after 40 days exposure.

Figure 6 shows that the experimental impedance spectra for anodized Mg (Dow #17) coated with two and three epoxy layers can be fit to the model suggested by Mansfeld, et al.[2] After exposure for approximately two months in 0.5 N NaCl, penetration of the coating by electrolyte

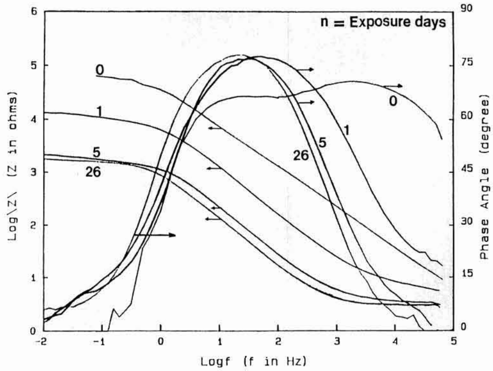

Figure 4—Bode plots in 0.5 N NaCl for anodized (Dow #17) Mg with water glass sealing

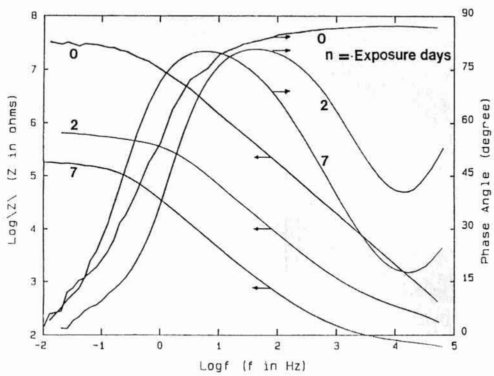

Figure 5—Bode plots in 0.5 N NaCl for anodized (Dow #17) Mg with one layer of epoxy coating

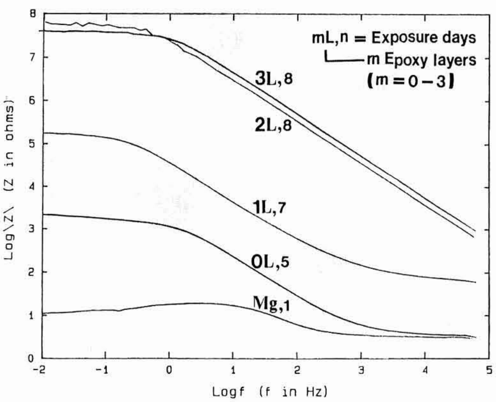

Figure 3—Bode plots in 0.5 N NaCl for bare Mg and anodized (Dow #17) Mg With water glass sealing or 1, 2, and 3 layers of epoxy coating

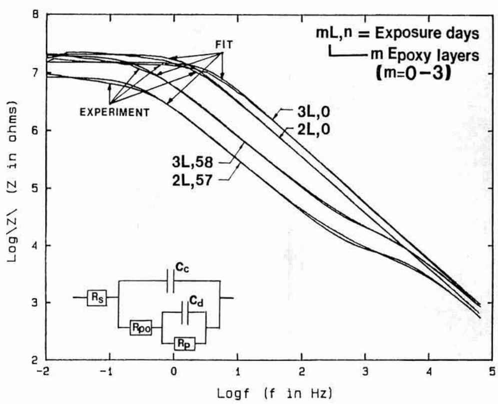

Figure 6—Experimental Bode plots in 0.5 N NaCl and fit to model [reference (2)] for anodized (Dow #17) Mg with two and three layers of epoxy coating

Table 1–Fit Parameters for the Spectra in *Figure* 6

Sample	$C_c(10^{-9}F)$	$R_{po}(10^3\Omega)$	$C_d(10^{-9}F)$	$R_p(10^6\Omega)$	C_{H_2O}(V/O)	A_{corr}
2L,0[a]	5.1	—	—	21.0	—	—
2L,57	5.4	8.75	63	8.5	1.3	$1.05\cdot10^{-2}$% (0.002 cm^2)
3L,0	3.1	—	—	15.4	—	—
3L,58	3.9	27.03	25	19.9	5.2	$4.2\cdot10^{-3}$% (0.0008 cm^2)

(a): mL,n: mL—epoxy layers m (m = 1-3); n—epoxy time in days n (n = 0-58).

and corrosion occurred at the metal/coating interface as shown by the appearance of the pore resistance, R_{po}, the polarization resistance, R_p, and the double layer capacitance, C_d (curves "3L,58" and "2L,57"). In *Table* 1, the fitted values for the model shown in *Figure* 6 are listed. The coatings capacitance, C_c, increases with exposure time due to the uptake of the electrolyte. Using the formula given by Brasher, et al.[6] the amount of water absorbed by the coating was calculated as 1.3% for the two-layer coating and 5.2% for the three-layer coating (*Table* 1). Both R_{po} and R_p have higher values for the three-layer coating reflecting its better corrosion protection. Based on the value of 30 μF/cm^2 for the ideal double layer capacitance C_d^0, the corroding area under the coating was calculated as 0.01% of the total area exposed (20 cm^2) for the two-layer coating and 0.004% for the three-layer coating. These results show that even after almost two months exposure to NaCl very little corrosion damage occurred.

The anodized surfaces coated with two epoxy layers had excellent corrosion resistance without any pitting until the end of the measurement—two months (curve "57" *Figure* 7). There is an indication of the development of conductive parts in the coating in agreement with the coating model. This became evident especially from the minimum of the phase angle at about 2 KHz after 28 days. The behavior becomes more pronounced after 57 days exposure.

Higher polarization resistance and the smaller capacitance values were measured for three epoxy layers (*Figure* 8), than for two epoxy layers. The changes of the impedance spectra are similar to those of the two-epoxy layers samples except for the higher pore resistance measured after two months exposure, which demonstrates the better corrosion resistance of the surface with three epoxy layers.

HAE

The corrosion resistance of the anodized (HAE) Mg with one to three epoxy layers is compared with that of bare Mg AZ31 in *Figure* 9. The curve for the bare Mg (curve "Mg") is characteristic for the pitting process, where an inductive response occurs at low frequency. HAE anodizing without sealing provides some corrosion resistance and the spectra, measured after one day exposure (curve "OL"), indicate a moderate increase of the polarization resistance. However, an inductive response appears with increasing exposure time and gas evolution from the surface demonstrates that pitting occurs. The great improvement of the corrosion resistance by dipping in epoxy resin is evident by the large increase of the impedance at low frequency in the spectra, measured after seven or 12 days exposure. Consideration of the capacitive region suggests that the first layer fills the pores of the oxide, while more dipping in epoxy resin builds up an epoxy layer which covers the whole surface. Two or three epoxy layers provide excellent corrosion protection in 0.5 N NaCl. Based on the capacitive response at higher frequency, it can be assumed that the thickness of coating layers may be 26 and 18 μm for three

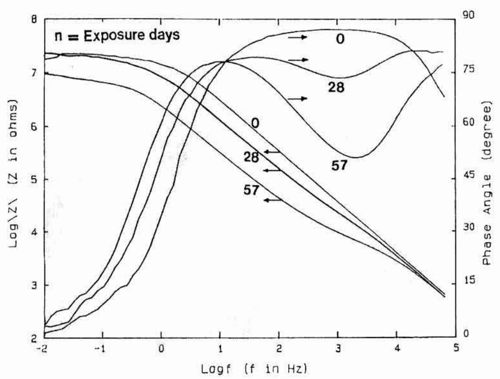

Figure 7—Bode plots in 0.5 N NaCl for anodized (Dow #17) Mg with two layers of epoxy coating

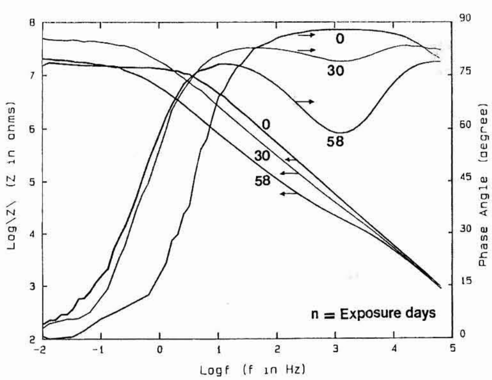

Figure 8—Bode plots in 0.5 N NaCl for anodized (Dow #17) Mg with three layers of epoxy coating

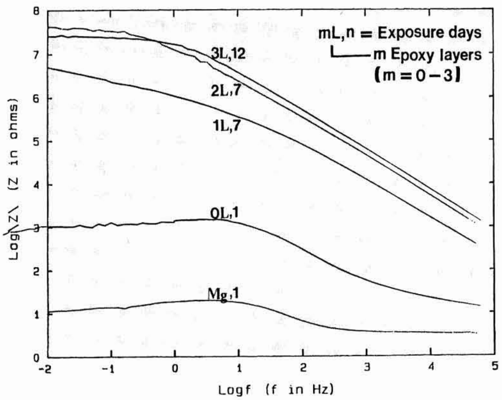

Figure 9—Bode plots in 0.5 N NaCl for bare Mg, anodized (HAE) Mg only, and coated with 1, 2, and 3 layers of epoxy

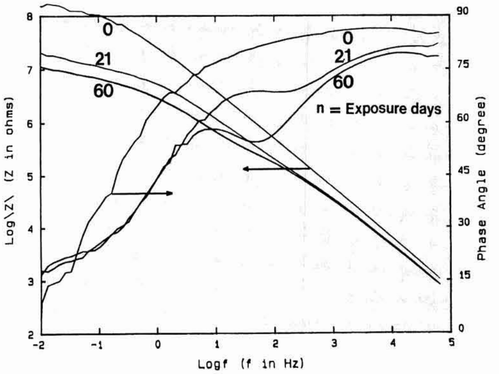

Figure 11—Bode plots in 0.5 N NaCl for anodized (HAE) Mg with two layers of epoxy coating

and two epoxy layers, respectively, based on a dielectric constant of 3.63. The resistive response at the low frequency shows that the dc limit is over $2 \cdot 10^8$ ohm·cm^2 for two and three layers of epoxy.

The changes of the impedance spectra for samples prepared with different numbers of epoxy layers on HAE-type oxide indicate their corrosion behavior as a function of exposure time in 0.5 N NaCl. The corrosion behavior of HAE anodized Mg AZ31 with one epoxy layer was measured for 50 days (*Figure* 10). After seven days (curve "7"), the anodized surface was affected by exposure into the 0.5 N NaCl solution as shown by the decrease of the impedance in the entire frequency spectrum. Apparently, one epoxy layer allows penetration of chloride ions through pores in the oxide. While the EIS curves changed much during the first 23 days, these changes were much less for the rest of the exposure period (curves "23" and "50") until the end of measurements, when pitting was observed. Observation of the exposed surface revealed a very fine pit without any visible corrosion products. One layer of epoxy on the HAE anodized surface (*Figure* 10) produced better corrosion resistance than on the Dow #17 anodized surface (*Figure* 5), as can be seen by the smaller changes of the impedance despite a longer exposure period.

Two epoxy layers provided excellent corrosion resistance without any observation of pitting until the end of the measurement after two months (curve "60" *Figure* 11). There is no clear indication of pore resistance, but observation of a minimum of the phase angle at about 100 Hz suggests that some conductive paths in the coating have been created.

Three epoxy layers provided excellent corrosion resistance during 55 days exposure without evidence of pitting (*Figure* 12). The spectra did not change significantly until the end of measurement.

Cr-Mn Coating

The corrosion behavior of the samples with the Cr-Mn conversion coating covered by epoxy coatings was quite different from that of the coated anodized surface. The corrosion resistance was inferior except for samples with three layers of epoxy, which provided better corrosion resistance than that of the corresponding anodized surface. *Figure* 13 indicates a large difference of the imped-

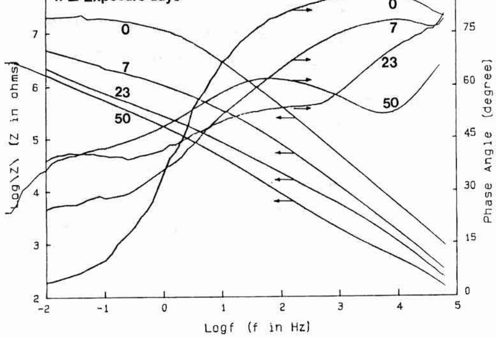

Figure 10—Bode plots in 0.5 N NaCl for anodized (HAE) Mg with one layer of epoxy coating

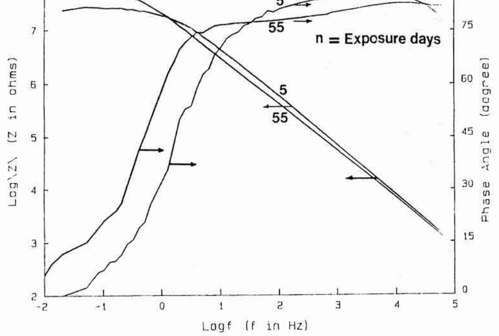

Figure 12—Bode plots in 0.5 NaCl for anodized (HAE) Mg with three layers of epoxy coating

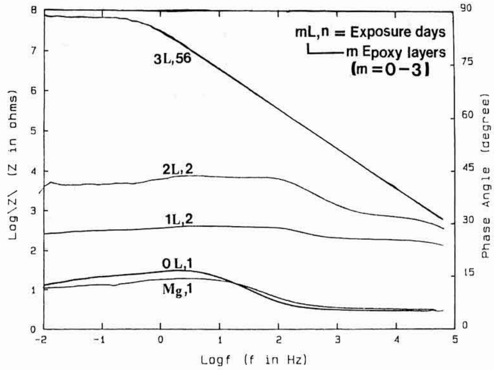

Figure 13—Bode plots in 0.5 N NaCl for bare Mg, conversion coated (Cr-Mn) Mg only, and coated with 1, 2, and 3 layers of epoxy

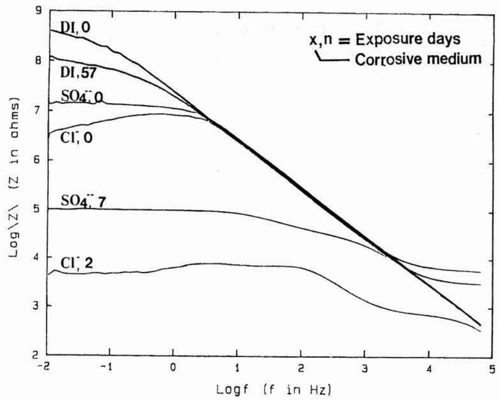

Figure 15—Bode plots in 0.5 N NaCl, Na_2SO_4, or DI water for Mg conversion coated (Cr-Mn) Mg with two layers of epoxy coating

ance spectra between samples with three epoxy layers and two layers. Three layers of epoxy coating survived without pitting until the end of the measurement after 56 days (curve "3L,56"), while samples with two layers pitted after only two days (curve "2L,2").

The Cr-Mn conversion coating alone could not provide any corrosion resistance in 0.5 N NaCl and produced an almost identical EIS curve to that for the bare Mg (compare curves "OL" and "Mg" in *Figure* 13). The curve for the Cr-Mn coating is only characteristic for the pitting process at the first measurement after two hours exposure, when severe evolution of gas bubbles was observed. The Cr-Mn coating on the metal surface is discontinuous (*Figure* 2) and the corrosive medium can easily reach the metal surface. Therefore, the main function of the Cr-Mn coating is to provide good adhesion of the epoxy coating on the Mg surface. Since one or two epoxy layers could not provide corrosion resistance over two days in 0.5 N NaCl (curves "1L" and "2L" in *Figure* 13), less aggressive media such as deionized water and 0.5 N Na_2SO_4 were used to compare the corrosion resistance of different coating systems.

Figure 14 shows that one epoxy layer cannot provide the desired corrosion resistance even in deionized water (curves "DI"). The impedance decreases and a pore resistance occurs during one week exposure (curve "DI,7"). One pit was observed at this time. In 0.5 N Na_2SO_4, the corrosion resistance was less than in DI water and pitting occurred after only one day (curves "SO_4^{2-},0" and "SO_4^{2-},1").

The sample with two epoxy layers had better corrosion resistance in deionized water for 57 days without pitting (curves "DI,0" and "DI,57" in *Figure* 15). The dc limit remained at over 10^8 ohm ($2 \cdot 10^9$ ohm·cm^2) at the end of the measurement. The sulfate ions were still aggressive as seen by the large decrease of the impedance during one week immersion. However, these changes were less than those observed in chloride media after two days.

Three layers of the epoxy coating provided excellent corrosion resistance in 0.5 N NaCl (*Figure* 16). For 56 days the capacitive response did not change, suggesting that the coating layer was perfectly inert against the aggressive medium. The same epoxy treatment on the anodized surfaces allowed the penetration of the electrolyte to

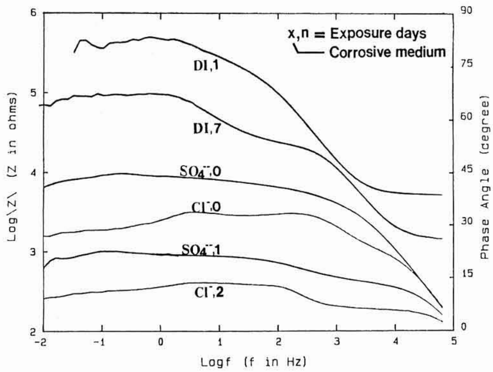

Figure 14—Bode plots in 0.5 N NaCl, Na_2SO_4, or DI water for Mg conversion coated (Cr-Mn) Mg with one layer of epoxy coating

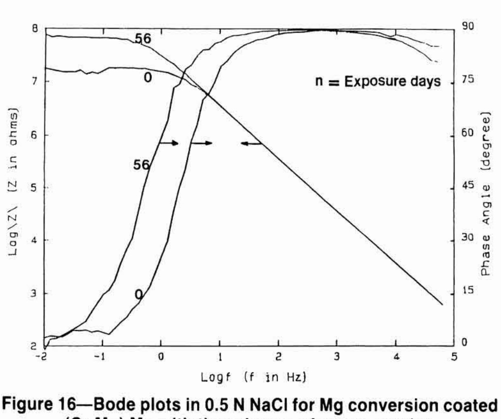

Figure 16—Bode plots in 0.5 N NaCl for Mg conversion coated (Cr-Mn) Mg with three layers of epoxy coating

the Mg surface as reflected in the impedance spectra by the appearance of a pore resistance after about one month immersion in 0.5 N NaCl (*Figures* 8 and 12). This may be caused by micropores in the anodized layer which were not sealed during the epoxy treatment. SEM micrography has identified some small pores in the anodized layer which were not sealed with epoxy.

CONCLUSION

Corrosion protection of Mg AZ31 in a marine environment can be achieved by proper sealing for anodized (Dow #17 or HAE) surfaces and a Cr-Mn conversion coated surface with an epoxy coating. The samples processed with the optimized procedure survived for a significant length of time without corrosion in the 0.5 N NaCl. Their corrosion resistance ranked in the order of decreasing resistance was as follows:

Cr-Mn (3L) > HAE (3L) > Dow #17 (3L) > HAE (2L) > Dow #17 (2L)

Insufficient sealing procedures allowed pitting corrosion of the anodized samples (one epoxy layer) after about one month exposure or pitting of Cr-Mn conversion coated samples (one or two epoxy layers) within two days in 0.5 N NaCl.

The water glass sealing on the Dow #17 anodized surface was effective in enhancing the corrosion resistance in 0.5 N NaCl, but it was not as good as one layer of epoxy. The HAE anodized surface without any sealing did not survive exposure to NaCl for one day. These results suggest that the pores in the oxide have to be sealed perfectly with an organic resin in order not to be exposed to the corrosive medium.

The Cr-Mn conversion coating by itself did not provide the necessary enhancement of corrosion protection in the aggressive environments, but it provides good adhesion for subsequent coating systems.

EIS has been an excellent method to analyze the corrosion processes at the metal/coating interface and to follow changes of the coating layers during the exposure to corrosive environments.

ACKNOWLEDGMENT

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Interlaboratory Testing of Viscosity in the Low Shear Rate Range (Below 10 Sec^{-1})

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Viscosity profiles of six coatings samples, three solvent-based and three water-borne, were determined on a variety of viscometers both in a shear rate increasing and decreasing mode. Included were the Bohlin, Carri-Med, Contraves, Haake Rotovisco, and computer driven Weissenberg viscometers. Each sample was run in duplicate at 25°C. Log viscosity-log shear rate profiles for each sample run were fitted by second order regression. Using the regression coefficients, viscosities were extrapolated to 10.0, 1.0, and 0.1 sec^{-1}. Statistical analysis showed that the standard deviation of the average viscosity increased as shear rate decreased. Also, better agreement was seen between viscometers in the shear rate decreasing than the shear rate increasing mode. For comparison, manual Weissenberg, Brookfield relaxation, and Falling Needle Viscometer data is included.

INTRODUCTION

Many investigators have shown the importance of low-shear rheology to the application and storage properties of coatings. In particular, sagging,[1] leveling,[2-4] pigment settling,[5,6] draining,[7] and penetrating[7] properties are all influenced by a coating's viscosity below 10 sec^{-1}. Many new additives have been developed which allow the formulator to manipulate these properties by changing the rheology in this region.[8,9] Until recently, measurements of viscosity at these low shear rates have been difficult to make, particularly if time-dependent measurements of thixotropic coatings were desired. With the advent of computer-driven viscometers, such measurements are now run routinely by more and more coating manufacturers and their suppliers.

The Technical Committee of the Cleveland Society for Coatings Technology investigated the agreement among several viscometers capable of measuring the viscosity of coatings in the low shear rate region. This study evaluated trends in comparative data for experimentally determined viscosities. It should not be considered an evaluation of viscometers. Because many coatings show thixotropic behavior,[10] viscosities were measured in both a shear rate increasing and decreasing mode. To digest the large volume of data generated, a data analysis scheme was developed. Direct comparisons of sample measurements could then be made between different instruments at different shear rates.

PROCEDURE

Commercially available coatings and a pigment dispersion were chosen for study rather than Newtonian fluids. Three water-borne and three solvent-based production samples were selected on the basis that they represented a wide range of product types and rheological behavior. Short descriptions of the samples appear in *Table* 1; to characterize them to the reader, results of standard coatings industry tests on each appear in *Table* 2.

Eight ounces were taken from each sample and sent with 12 wooden stirrers to participating laboratories for rheological testing. Accompanying the samples was a cover letter describing proper sample handling and test parameters. The following instructions were given:

Sample Preparation: When the samples arrive, store them as close to 25°C as possible until the test date. Twenty-four hours prior to testing, mix each sample until uniform with a minimum of 50 hand-stirs per sample (use

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Table 1—Test Samples

Sample	Type	Description
A . . .	Water-borne	Styrenated acrylic flat roof coating containing a cellulosic thickener
B . . .	Water-borne	Exterior latex semigloss containing a urethane-type associative thickener
C . . .	Water-borne	Latex semigloss containing an alkali-swellable associative thickener
D . . .	Solvent-based	High solids phenolic-alkyd semigloss
E . . .	Solvent-based	Oleoresinous varnish
F . . .	Solvent-based	Titanium dioxide dispersion in alkyd and mineral spirits

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provided stirrers). One hour before testing, remix each sample with exactly 50 hand-stirs. Incorporation of air should be avoided during mixing to prevent changes in sample rheology.

INSTRUMENT CONFIGURATION: Select the instrument configuration that will give the widest shear rate range possible with 10 sec^{-1} as the maximum. We are particularly interested in very low shear rates. Maintain sample temperature at 25°C during testing. Use this configuration for all samples.

TESTING: Test the samples as close to the specified date as possible (about one month after shipping). Transfer samples to the viscometer using the provided stirrers (do not use a syringe). The samples should be disturbed as little as possible to prevent the breakdown of any at-rest structure. Over a period of 180 sec, increase the shear rate from the minimum to 10 sec^{-1}, hold this shear rate for 60 sec, then decrease the shear rate back to the minimum over another 180 sec. If this is not possible, please report the procedure used.

PRECISION: Run each sample twice. Use fresh sample for each run. If the viscosities of the two runs do not agree within 5% of each other at all shear rates selected, rerun the sample a third time. Report the data of each run separately; do not average results.

REPORTING RESULTS: The raw data should be reported in tabular form and should include the shear rates and shear stresses for each sample and each run. Additional graphical presentation of the data is optional.

The sample preparation procedure was chosen in an attempt to obtain consistency in pretest shear history without destroying the at-rest structure of the samples.

Samples were tested on five computer-driven and three manual viscometers. Reported variations in the testing procedure for the computer-driven viscometers were:

The Carri-Med Controlled Stress Rheometer was maintained at a constant shear stress during the steady-state portion of the thixotropic loop. Therefore, shear rates could vary several sec^{-1} during this portion of the run.

The steady-state portion of the thixotropic loop was not reported for runs on the Contraves viscometer. No time delay was reported between the shear rate ascending and descending portions of the test.

Table 2—Properties of Test Samples

		Viscosity			Leneta
Sample	lb/gal	Stormer KU[a]	ICI Poise[b]	N.Y.P.C. Leveling[c]	Anti-Sag[d]
A . . .	12.0	110	1.85	0	>24
B. . . .	10.2	96	1.25	6	11
C. . . .	10.6	104	1.65	4	16
D . . .	10.0	77	1.90	8	3
E. . . .	7.4	52	0.75	10	< 3
F. . . .	15.8	122	>5.00	7	4

(a) ASTM D 562-81, Consistency of Paints Using the Stormer Viscometer, Procedure A, 25°C.
(b) ASTM D 4287-83, Determination of Viscosity of Paints and Varnishes at a High Rate of Shear by ICI Cone/Plate Viscometer, 0-5 poise scale, 10,000 sec^{-1}, 25°C.
(c) ASTM D 2801-69, Leveling Characteristics of Paints by Drawdown Method, 10 = excellent, 0 = poor.
(d) ASTM D 4400-84, Sag Resistance of Paints Using a Multinotch Applicator, Method A, mils.

Table 3—Viscometers

Instrument	Type[a]	Distributor
Bohlin Reologi VOR . . . 25 mm couette	Concentric cylinder	Bohlin Reologi, Inc. P.O. Box 6623 Edison, NJ 08818
Carri-Med Controlled . . Stress Rheometer 0.5°, 4 cm cone	Cone and plate	Mitech Corp. 4399 Hamann Parkway Willoughby, OH 44094
Contraves Rheomat 115 and Low-Shear 30 DIN system	Concentric cylinder	Contraves Industrial Products Division 11258 Cornell Park Drive, Suite 612 Cincinnati, OH 45242
Haake Rotovisco . . . . . . RV 20 CV 100 system	Concentric cylinder	Haake Buchler Instruments, Inc. 244 Saddle River Road Saddle Brook, NJ 07662
Irvine-Park Falling. . . . . Needle Viscometer (FNV)	Falling needle	J&L Instruments Corp. 2430 Boulevard of the Generals Valley Forge Business Center Norristown, PA 19403
Wells-Brookfield RVT . . CP-51 and CP-42 cones	Cone and plate	Brookfield Engineering Laboratories 240 Cushing Street Stoughton, MA 02072
Weissenberg Rheometer .	Cone and plate	Mitech Corp. 4399 Hamann Parkway Willoughby, OH 44094

(a) Instrument configuration used in this study, other configurations are available for many of these viscometers.

Table 4—Regression Coefficients for the Cellulosic-Thickened Water-Borne Roof Coating (Sample A)

		Shear Rate Increasing					Shear Rate Decreasing		
Viscometer	A_0	A_1	A_2	R	Viscometer	A_0	A_1	A_2	R
Bohlin	2.4090	−0.76938	−0.01791	0.99971	Bohlin	2.3993	−0.77045	−0.00383	0.99992
	2.3767	−0.74779	−0.02430	0.99971		2.3685	−0.74975	−0.01145	0.99990
Carri-Med	2.6257	−0.84450	−0.00947	0.99956	Carri-Med	2.6443	−0.84650	0.01410	0.99853
	2.6036	−0.81951	−0.03797	0.99918		2.6696	−0.85623	−0.01407	0.99997
Contraves	2.5122	−0.83334	0.03861	0.99998	Contraves	2.5075	−0.81385	0.02129	0.99997
	2.5232	−0.82261	0.02937	0.99999		2.5239	−0.80799	0.01821	0.99997
Haake	2.5605	−0.83495	0.01976	0.99980	Haake	2.5252	−0.78121	−0.00965	0.99981
	2.5441	−0.83495	0.00330	0.99995		2.5318	−0.79135	−0.00005	0.99991
Weissenberg, computer	2.7325	−0.96913	−0.05353	0.99850	Weissenberg, computer	2.4435	−0.75084	0.01581	0.99969
	2.6319	−0.82062	0.02118	0.99969		2.4754	−0.75071	0.00638	0.99946

Manual Viscometers

Viscometer	A_0	A_1	A_2	R
Brookfield	2.4693	−0.75836	−0.02820	0.99833
Relaxation	2.5352	−0.73192	−0.04479	0.99885
FNV	2.5010	−0.84591	−0.00488	0.99835
Weissenberg	2.4029	−0.83550	0.10133	1.00000

Table 5—Regression Coefficients for the Latex Semigloss Containing a Urethane-Type Associative Thickener (Sample B)

		Shear Rate Increasing					Shear Rate Decreasing		
Viscometer	A_0	A_1	A_2	R	Viscometer	A_0	A_1	A_2	R
Bohlin	1.7088	−0.34666	−0.06072	0.99999	Bohlin	1.6674	−0.31764	−0.05234	0.99997
	1.7043	−0.34491	−0.06040	0.99998		1.6642	−0.31582	−0.05296	0.99997
Carri-Med	1.6920	−0.40912	0.05324	0.99947	Carri-Med	1.7727	−0.41350	−0.03277	0.99984
	1.6949	−0.39629	0.04960	0.99908		1.7622	−0.33996	−0.09706	0.99745
Contraves	1.7218	−0.35016	−0.05192	0.99994	Contraves	1.7207	−0.43327	0.03560	0.99976
	1.7809	−0.43618	−0.02056	0.99987		1.7275	−0.43984	0.03685	0.99967
Haake	1.7760	−0.31937	−0.09954	0.99961	Haake	1.7423	−0.41911	0.04254	0.99899
	1.7885	−0.37329	−0.03998	0.99987		1.7524	−0.43046	0.05904	0.99889
Weissenberg, computer	1.9160	−0.51148	−0.06115	0.98707	Weissenberg, computer	1.7097	−0.35492	0.00936	0.99559
	1.9758	−0.55209	−0.06940	0.98416		1.7582	−0.36364	−0.00111	0.99814

Manual Viscometers

Viscometer	A_0	A_1	A_2	R
Brookfield	1.7154	−0.40567	0.02601	0.99943
Relaxation	1.7343	−0.38680	0.03202	0.99784
FNV	1.8304	−0.26919	0.08648	0.99978
Weissenberg	1.8261	−0.36642	−0.07130	1.00000

Table 6—Regression Coefficients for the Latex Semigloss Containing an Alkali-Swellable Associative Thickener (Sample C)

		Shear Rate Increasing					Shear Rate Decreasing		
Viscometer	A_0	A_1	A_2	R	Viscometer	A_0	A_1	A_2	R
Bohlin	1.8792	−0.47256	−0.05744	0.99797	Bohlin	1.8239	−0.46138	−0.00570	0.99988
	1.8781	−0.46807	−0.05970	0.99828		1.8273	−0.46268	−0.00554	0.99986
Carri-Med	1.7828	−0.53043	0.04585	0.99950	Carri-Med	1.7492	−0.42631	−0.02175	0.99959
	1.8452	−0.51960	0.03160	0.99924		1.8329	−0.44392	−0.03139	0.99917
Contraves	1.9816	−0.52570	0.00346	0.99968	Contraves	1.9551	−0.54678	0.05180	0.99998
	1.9614	−0.51092	0.01221	0.99990		1.9584	−0.54920	0.05246	0.99998
Haake	1.9143	−0.41162	−0.08617	0.99709	Haake	1.9113	−0.54599	0.06679	0.99979
	1.9674	−0.50156	−0.05369	0.99259		1.9157	−0.54607	0.06579	0.99993
Weissenberg, computer	2.2507	−0.69065	−0.05933	0.99541	Weissenberg, computer	1.9041	−0.45498	0.05434	0.99990
	2.3003	−0.71125	−0.06560	0.99569		1.9330	−0.45958	0.05189	0.99986

Manual Viscometers

Viscometer	A_0	A_1	A_2	R
Brookfield	1.9733	−0.55212	0.08732	0.99996
Relaxation	1.9725	−0.54879	0.08150	0.99993
FNV	2.1116	−0.59520	0.04272	0.99991
Weissenberg	2.0170	−0.53949	0.37461	1.00000

Table 7—Regression Coefficients for the Solvent-Based, High Solids Semigloss (Sample D)

	Shear Rate Increasing					Shear Rate Decreasing			
Viscometer	A_0	A_1	A_2	R	Viscometer	A_0	A_1	A_2	R
Bohlin	1.0838	−0.21656	−0.11637	0.98981	Bohlin	0.98541	−0.20951	−0.01828	0.99821
	1.0960	−0.22528	−0.11796	0.98762		0.98756	−0.21145	−0.01353	0.99844
Carri-Med	0.96046	−0.10865	−0.04799	0.98380	Carri-Med	1.0526	−0.23686	−0.03669	0.99822
	1.0072	−0.10922	−0.04392	0.97351		1.1061	−0.26452	−0.02717	0.99737
Contraves	0.99833	−0.19932	−0.00938	0.99610	Contraves	1.0210	−0.33401	0.10595	0.99951
	1.0595	−0.25150	−0.01319	0.99769		1.0222	−0.33053	0.10753	0.99933
Haake	1.1813	−0.26131	−0.12154	0.98268	Haake	1.0535	−0.30876	0.07151	0.99808
	1.1343	−0.19331	−0.14381	0.97417		1.0535	−0.28742	0.04654	0.99933
Weissenberg, computer	1.3551	−0.43556	−0.01667	0.99781	Weissenberg, computer	1.0288	−0.27131	0.05979	0.99800
	1.3691	−0.35628	0.01870	0.98712		1.0041	−0.29879	0.04648	0.99440

Manual Viscometers

Viscometer	A_0	A_1	A_2	R
Brookfield	1.0049	−0.31981	0.05135	0.99726
Relaxation	0.94479	−0.34524	0.05771	0.99814
FNV	1.3084	−0.28542	−0.02853	0.98009
Weissenberg	1.2000	−0.32949	−0.20057	1.00000

Table 8—Regression Coefficients for the Solvent-Based Varnish (Sample E)

	Shear Rate Increasing					Shear Rate Decreasing			
Viscometer	A_0	A_1	A_2	R	Viscometer	A_0	A_1	A_2	R
Bohlin	0.013450	0.01608	−0.00885	0.99519	Bohlin	0.00063478	0.06192	−0.04366	0.98947
	0.0084369	−0.02280	−0.01280	0.99553		0.024118	−0.01125	0.00681	0.98172
Carri-Med	0.075716	−0.08143	−0.01982	0.90398	Carri-Med	0.0031425	0.04651	−0.07292	0.71946
	0.11410	−0.19566	0.13802	0.96894		0.019177	0.09564	−0.08554	0.91364
Contraves	0.026808	0.05233	−0.02018	0.93548	Contraves	0.088025	−0.11932	0.10532	0.99355
	0.027498	0.05248	−0.02104	0.93123		0.088871	−0.11928	0.10471	0.99369
Haake	0.098702	−0.06864	0.03752	0.99458	Haake	−0.12561	−0.21071	0.16983	0.99458
	0.071663	−0.04292	0.04332	0.74943		−0.12225	−0.16505	0.12190	0.99617
Weissenberg, computer	0.058460	0.00827	−0.01035	0.99876	Weissenberg, computer	0.058460	0.00827	−0.01035	0.99876
	0.056356	0.00885	−0.00939	0.99413		0.058460	0.00827	−0.01035	0.99876

Manual Viscometers

Viscometer	A_0	A_1	A_2	R
FNV	0.021881	−0.00075	0.00478	0.86403
Weissenberg	0.25647	−0.09519	−0.07894	1.00000

Table 9—Regression Coefficients for the Titanium Dioxide Dispersion (Sample F)

	Shear Rate Increasing					Shear Rate Decreasing			
Viscometer	A_0	A_1	A_2	R	Viscometer	A_0	A_1	A_2	R
Bohlin	1.7428	−0.37020	−0.01474	0.97326	Bohlin	1.6343	−0.31620	0.05507	0.99845
	1.7452	−0.36388	−0.02828	0.99004		1.6363	−0.33150	0.06239	0.99894
Carri-Med	1.6970	−0.22433	−0.04775	0.98856	Carri-Med	1.7277	−0.39497	0.09468	0.99974
	1.6939	−0.18566	−0.08825	0.97807		1.7281	−0.39710	0.08703	0.99906
Contraves	2.2556	−0.89715	0.20856	1.00000	Contraves	2.1285	−0.66780	0.09014	0.99978
	2.1910	−0.81376	0.17975	1.00000		2.1271	−0.67176	0.08946	0.99983
Haake	1.5153	0.02592	−0.15995	0.95415	Haake	1.6203	−0.37540	0.13748	0.99989
	1.5464	−0.03023	−0.11711	0.97522		1.6408	−0.35910	0.11731	0.99989
Weissenberg, computer	2.0447	−0.60084	−0.05200	0.98526	Weissenberg, computer	1.5942	−0.32263	0.04994	0.99828
	2.1907	−0.61693	−0.06610	0.99144		1.6566	−0.24363	0.03927	0.99550

Manual Viscometers

Viscometer	A_0	A_1	A_2	R
Brookfield	1.7137	−0.47512	0.15936	0.99966
Relaxation	1.7128	−0.46793	0.16506	0.99958
FNV	2.1306	−0.60424	0.03361	0.99652
Weissenberg	1.6798	−0.17423	−0.02988	1.00000

Table 10—Extrapolated Viscosities (in Poise) of the Cellulosic-Thickened Water-Borne Roof Coating (Sample A)

Shear Rate Increasing				Shear Rate Decreasing			
	Shear Rate				Shear Rate		
Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}	Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Bohlin	41.85	256.4	1447	Bohlin	42.17	250.8	1465
	40.24	238.1	1259		40.49	233.6	1279
Carri-Med	59.12	422.4	2889	Carri-Med	64.85	440.9	3198
	55.73	401.4	2427		62.99	467.3	3249
Contraves	52.18	325.2	2422	Contraves	51.87	321.7	2201
	53.70	333.6	2372		52.98	326.5	2188
Haake	55.63	363.5	2601	Haake	54.24	335.1	1980
	55.70	350.0	2233		55.00	340.3	2104
Weissenberg, computer	51.27	540.1	4447	Weissenberg, computer	51.11	277.7	1622
	61.67	428.4	2700		53.84	298.8	1708
Average	52.71	365.9	2480	Average	52.95	329.3	2099
Standard Deviation	6.87	88.2	865	Standard Deviation	7.64	75.0	668
St. Dev. as % of Avg.	13.0	24.1	34.9	St. Dev. as % of Avg.	14.4	22.8	31.8

Manual Viscometers

	Shear Rate		
Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Brookfield Relaxation	48.17	294.6	1583
	57.34	342.9	1669
Falling Needle Visc.	44.69	317.0	2198
Weissenberg, manual	46.64	252.9	2186

Manual viscometers were: Brookfield relaxation,[11,12] steady-state Weissenberg, and the Falling Needle Viscometer (FNV).[13] These were included for comparative purposes as alternatives to computer-driven instruments. The Brookfield relaxation technique measures viscosities in an exponentially decreasing shear rate mode; the manual Weissenberg viscometer measured steady-state equilibrium viscosities; and the Falling Needle Viscometer gave viscosities of previously unsheared samples. Because these manual viscometers could not run the thixotropic loop specified, they were not included in the data analysis. Viscometers included in this study and their suppliers appear in *Table* 3.

DATA ANALYSIS

If three runs were made on one viscometer for a sample, the two runs which had the closest agreement were selected for analysis. Log viscosity as a function of log

Table 11—Extrapolated Viscosities (in Poise) of the Latex Semigloss Containing a Urethane-Type Associative Thickener (Sample B)

Shear Rate Increasing				Shear Rate Decreasing			
	Shear Rate				Shear Rate		
Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}	Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Bohlin	20.02	51.14	98.8	Bohlin	19.83	46.49	85.6
	19.91	50.62	97.5		19.74	46.15	84.5
Carri-Med	21.68	49.20	142.7	Carri-Med	21.20	59.25	142.4
	22.30	49.53	138.3		21.14	57.84	101.2
Contraves	20.88	52.70	104.7	Contraves	21.04	52.57	154.7
	21.09	60.38	157.2		21.11	53.39	160.0
Haake	22.76	59.70	99.0	Haake	23.21	55.25	159.9
	23.73	61.45	132.4		24.04	56.55	174.5
Weissenberg, computer	22.05	82.41	232.5	Weissenberg, computer	23.13	51.25	118.6
	22.61	94.58	287.4		24.74	57.31	132.0
Average	21.70	61.17	149.1	Average	21.92	53.61	131.3
Standard Deviation	1.23	15.39	63.5	Standard Deviation	1.74	4.57	32.5
St. Dev. as % of Avg.	5.7	25.2	42.6	St. Dev. as % of Avg.	7.9	8.5	24.8

Manual Viscometers

	Shear Rate		
Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Brookfield Relaxation	21.66	51.93	140.3
	23.96	54.24	142.3
Falling Needle Visc.	44.43	67.67	153.5
Weissenberg, manual	24.46	67.00	132.2

Table 12—Extrapolated Viscosities (in Poise) of the Latex Semigloss Containing an Alkali-Swellable Associative Thickener (Sample C)

Shear Rate Increasing

Viscometer	Shear Rate 10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Bohlin	22.35	75.72	196.9
	22.40	75.53	193.4
Carri-Med	19.87	60.65	228.6
	22.76	70.02	249.1
Contraves	28.80	95.85	324.2
	29.02	91.50	305.2
Haake	26.09	82.09	173.7
	25.83	92.77	260.2
Weissenberg, computer	31.68	178.11	762.1
	33.38	199.66	883.0
Average	26.22	102.19	357.7
Standard Deviation	4.44	47.24	251.2
St. Dev. as % of Avg.	16.9	46.2	70.2

Shear Rate Decreasing

Viscometer	Shear Rate 10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Bohlin	22.74	66.67	190.4
	22.86	67.19	192.5
Carri-Med	20.00	57.84	142.5
	22.78	56.13	176.0
Contraves	28.85	90.18	357.8
	28.95	90.87	363.1
Haake	27.05	81.53	334.3
	27.25	82.36	336.9
Weissenberg, computer	31.88	80.19	259.1
	33.52	85.70	278.3
Average	26.59	75.87	263.1
Standard Deviation	4.40	12.88	83.1
St. Dev. as % of Avg.	16.5	17.0	31.6

Manual Viscometers

Viscometer	Shear Rate 10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Brookfield Relaxation	32.25	94.04	410.0
	32.00	93.86	400.7
Falling Needle Visc.	36.23	129.30	561.7
Weissenberg, manual	71.14	103.99	853.3

shear rate was fitted by second order regression[14,15] for both the shear rate increasing and shear rate decreasing mode. This gave the following general equation for the viscosity profiles:

$$\log(\text{viscosity}) = A_0 + A_1 \log(\text{shear rate}) + A_2 [\log(\text{shear rate})]^2 \quad (1)$$

Regression coefficients (A_0, A_1, and A_2) and correlation coefficients (R) for the samples appear in *Tables* 4-9. These constants are provided to allow reconstruction of the experimental data.

Using the fitted equations, viscosities for each run were extrapolated to 10.0, 1.0, and 0.1 sec^{-1} for both the shear rate increasing and shear rate decreasing mode. For these special cases, equation (1) can be simplified to:

$$\log(\text{viscosity at } 10.0 \text{ sec}^{-1}) = A_0 + A_1 + A_2 \quad (2)$$

$$\log(\text{viscosity at } 1.0 \text{ sec}^{-1}) = A_0 \quad (3)$$

$$\log(\text{viscosity at } 0.1 \text{ sec}^{-1}) = A_0 - A_1 + A_2 \quad (4)$$

Table 13—Extrapolated Viscosities (in Poise) of the Solvent-Based, High Solids Semigloss (Sample D)

Shear Rate Increasing

Viscometer	Shear Rate 10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Bohlin	5.635	12.13	15.28
	5.659	12.47	15.97
Carri-Med	6.365	9.13	10.50
	7.146	10.17	11.82
Contraves	6.161	9.96	15.43
	6.235	11.47	19.85
Haake	6.287	15.18	20.94
	6.269	13.62	15.27
Weissenberg, computer	7.996	22.65	59.42
	10.753	23.39	55.47
Average	6.851	14.02	24.00
Standard Deviation	1.537	5.07	17.93
St. Dev. as % of Avg.	22.4	36.2	74.7

Shear Rate Decreasing

Viscometer	Shear Rate 10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Bohlin	5.723	9.67	15.02
	5.789	9.72	15.33
Carri-Med	6.012	11.29	17.90
	6.522	12.77	22.05
Contraves	6.208	10.50	28.90
	6.298	10.52	28.86
Haake	6.550	11.31	27.15
	6.496	11.31	24.40
Weissenberg, computer	6.566	10.69	22.90
	6.647	10.09	22.35
Average	6.281	10.79	22.49
Standard Deviation	0.337	0.93	5.12
St. Dev. as % of Avg.	5.4	8.6	22.8

Manual Viscometers

Viscometer	Shear Rate 10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Brookfield Relaxation	5.451	10.11	23.77
	4.542	8.81	22.27
Falling Needle Visc.	9.873	20.34	36.75
Weissenberg, manual	4.677	15.85	21.33

Table 14—Extrapolated Viscosities (in Poise) of the Solvent-Based Varnish (Sample E)

Shear Rate Increasing				Shear Rate Decreasing			
	Shear Rate				Shear Rate		
Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}	Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Bohlin	1.049	1.031	0.974	Bohlin	1.044	1.001	0.785
	0.939	1.020	1.043		1.046	1.057	1.102
Carri-Med	0.943	1.190	1.372	Carri-Med	0.948	1.007	0.765
	1.139	1.300	2.804		1.070	1.045	0.689
Contraves	1.145	1.064	0.900	Contraves	1.186	1.225	2.054
	1.145	1.065	0.899		1.187	1.227	2.055
Haake	1.168	1.255	1.603	Haake	0.682	0.749	3.207
	1.180	1.179	1.438		0.683	0.755	1.461
Weissenberg, computer	1.139	1.144	1.096	Weissenberg, computer	1.139	1.144	1.096
	1.137	1.139	1.092		1.139	1.144	1.096
Average	1.098	1.139	1.322	Average	1.012	1.035	1.431
Standard Deviation	0.090	0.095	0.573	Standard Deviation	0.189	0.170	0.794
St. Dev. as % of Avg.	8.2	8.3	43.3	St. Dev. as % of Avg.	18.7	16.4	55.5

Manual Viscometers

	Shear Rate		
Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Falling Needle Visc.	1.061	1.052	1.065
Weissenberg, manual	1.209	1.805	1.874

Averages and standard deviations of the extrapolated viscosities were calculated for the computer-driven viscometers. These results and the extrapolated viscosities for the manual viscometers appear in *Tables* 10-15.

Average second order regression coefficients were calculated from the average extrapolated viscosities for the computer-driven viscometers. They were not calculated by averaging the individual regression coefficients. These coefficients represent log quantities and averaging them would artificially increase the importance of lower viscosity values. These coefficients appear in *Table* 16 and the resulting average viscosity profiles of the water-borne and solvent-based samples appear in *Figures* 1 and 2, respectively.

Brookfield relaxation measurements were made by rotating the cone of the instrument and fixing its position at a scale reading of 100. After the sample was introduced, the cone was released and scale readings were recorded at set time intervals. During the relaxation, the shear stress applied to the sample is proportional to the scale reading (S):

$$\text{Shear stress} = C_1 S \qquad (5)$$

Table 15—Extrapolated Viscosities (in Poise) of the Titanium Dioxide Dispersion (Sample F)

Shear Rate Increasing				Shear Rate Decreasing			
	Shear Rate				Shear Rate		
Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}	Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Bohlin	22.80	55.31	125.4	Bohlin	23.61	43.08	101.3
	22.54	55.62	120.4		23.29	43.28	107.2
Carri-Med	26.60	49.77	74.7	Carri-Med	26.76	53.42	164.9
	26.30	49.42	61.8		26.18	53.47	163.0
Contraves	36.90	180.14	2297.8	Contraves	35.55	134.43	769.9
	36.06	155.24	1529.4		35.06	134.00	773.3
Haake	24.06	32.76	21.4	Haake	24.12	41.72	135.9
	25.06	35.19	28.8		25.06	43.73	131.0
Weissenberg, computer	24.65	110.84	392.2	Weissenberg, computer	20.97	39.29	92.6
	32.19	155.16	551.5		28.33	45.35	87.0
Average	27.72	87.95	520.3	Average	26.89	63.18	252.6
Standard Deviation	5.35	56.72	775.3	Standard Deviation	4.88	37.73	274.9
St. Dev. as % of Avg.	19.3	64.5	149.0	St. Dev. as % of Avg.	18.1	59.7	108.8

Manual Viscometers

	Shear Rate		
Viscometer	10 sec^{-1}	1.0 sec^{-1}	0.1 sec^{-1}
Brookfield Relaxation	25.00	51.72	222.9
	25.70	51.62	221.7
Falling Needle Visc.	36.31	135.08	586.7
Weissenberg, manual	29.90	47.84	66.7

Table 16—Average Regression Coefficients

Shear Rate Increasing

Sample	Average Regression Coefficients A_0	A_1	A_2
A	2.5634	−0.83628	−0.00519
B	1.7865	−0.41851	−0.03157
C	2.0094	−0.56744	−0.02333
D	1.1467	−0.27223	−0.03877
E	0.0565	−0.04032	0.02439
F	1.9442	−0.63673	0.13529

Shear Rate Decreasing

Sample	Average Regression Coefficients A_0	A_1	A_2
A	2.5176	−0.79907	0.00535
B	1.7292	−0.38871	0.00031
C	1.8801	−0.49770	0.04235
D	1.0330	−0.27698	0.04199
E	0.0149	−0.07523	0.06547
F	1.8006	−0.48642	0.11543

where C_1 is a proportionality constant determined by the physical characteristics of the instrument. The shear rate is proportional to the relaxation rate of the cone:

$$\text{Shear rate} = C_2 \frac{dS}{dt} \quad (6)$$

where C_2 is a different constant also determined by the physical characteristics of the instrument. To obtain a viscosity profile the quantity dS/dt must be determined at each scale reading during the relaxation. This was accomplished by taking three successive scale readings and fitting them to a parabolic equation of the form:

$$\text{scale reading at time } t = B_0 + B_1 t + B_2 t^2 \quad (7)$$

where B_0, B_1, and B_2 are fitted constants.[16] The derivative of this equation (dS/dt) was then calculated for the middle point:

$$\frac{dS}{dt} = B_1 + 2B_2 t \quad (8)$$

This procedure was repeated for the entire data set yielding shear rate as a function of shear stress which was then converted to viscosity by the fundamental equation:

$$\text{Viscosity} = \frac{\text{shear stress}}{\text{shear rate}} \quad (9)$$

DISCUSSION

A log-log regression was chosen over more familiar rheological models such as the Casson equation[17,18] or a power law expression[19] to fit the data over the shear rate region of interest. The purpose of the fit was to precisely extrapolate the viscosities obtained on the different instruments to preselected shear rates rather than to predict more theoretical properties such as the yield value[18] or flow index.[20] Also, these other models are generally used when a viscosity profile over a much broader shear rate region is known.

Overall, a second order fit was found to represent the data quite well. Correlation coefficients (R) for all samples except the solvent-based varnish (E) were greater than 0.95 for all viscometers; most were greater than 0.99. Only three runs on the varnish had correlation coefficients below 0.90. The correlation coefficients of all runs performed on the manual Weissenberg viscometer were 1.00000 since only three data points were obtained during the shear rate increasing or decreasing mode.

All samples except the varnish consistently gave negative A_1 coefficients indicating that they were shear-thin-

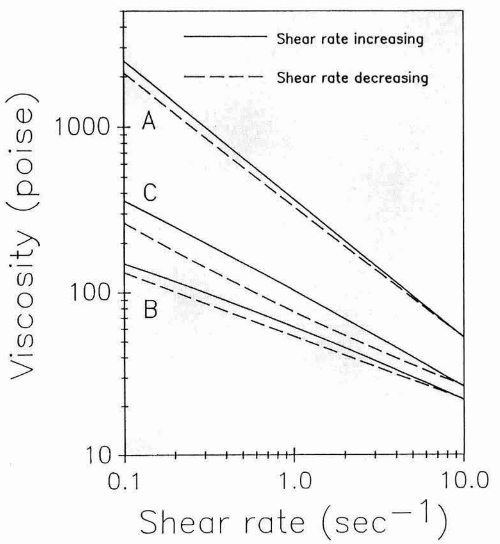

Figure 1—Average viscosity profiles of water-borne samples

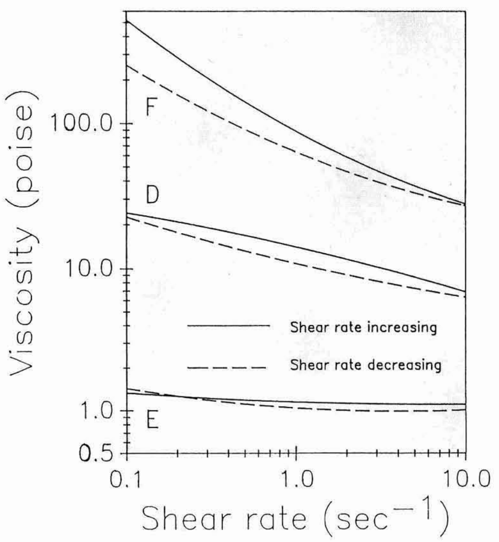

Figure 2—Average viscosity profiles of solvent-based samples

ning. Samples with smaller A_1 values (more negative) were generally more shear-thinning (see *Figures* 1 and 2). The magnitude of the A_1 values for sample E was much smaller than that of the other samples. This indicates the solvent-based varnish was fairly close to being a Newtonian fluid.

As shear rate decreased, agreement between viscometers decreased. For the water-borne cellulosic-thickened roof coating (A), standard deviations (as a percent of the average) in the shear rate increasing mode were 13.0%, 24.1%, and 34.9% for measurements at 10.0, 1.0, and 0.1 sec^{-1}, respectively. Generally, this trend occurred with all samples in both the shear rate increasing and decreasing modes.

Agreement between viscometers was better in the shear rate decreasing than the shear rate increasing mode. The standard deviations (as a percent of the average) for the solvent-based high solids alkyd (D) were 22.4%, 36.2%, and 74.7% for measurements in the shear rate increasing mode at 10.0, 1.0, and 0.1 sec^{-1}, respectively. In the shear rate decreasing mode, they were 5.4%, 8.6%, and 22.4% over the same shear rates. These results were fairly typical of all samples except E, where the opposite trend was seen. The difference in the agreement between the two parts of the thixotropic curve shows the importance of sample handling and preparation. Agreement is poorer in the shear rate increasing mode because factors such as rate of sample stirring, method of sample introduction into the viscometer, and rate of cone or cylinder lowering onto the sample, all disturb the at-rest structure of the sample. As a result, the low-shear viscosity of these thixotropic coatings is changed. In the shear rate decreasing mode, all samples have already undergone part of the thixotropic loop and their shear history is much more similar.

Because the varnish (E) shows nearly Newtonian behavior, agreement of measurements made in the shear rate increasing and decreasing modes should have been similar. However, agreement was better in the first part of the thixotropic loop (shear rate increasing) and may be due to the effect of solvent evaporation as the experiment progressed. This may explain why the average viscosity of the varnish at 0.1 sec^{-1} was lower at the beginning of the thixotropic loop than at the end.

Agreement between viscometers was poorest for the solvent-based titanium dioxide dispersion (F) in both the shear rate increasing and decreasing modes. This sample had the greatest thixotopic behavior (the largest area in the thixotropic loop—see *Figure* 2) and, therefore, should be the most sensitive to variations in shear history.

The Brookfield relaxation technique gave results similar to many of the computer-driven viscometers. However, viscosities could only be measured in an exponentially decreasing shear rate mode and over a limited region. Also, samples with low viscosities over this shear rate region may cause the relaxation to occur too quickly for accurate readings. Brookfield relaxation measurements were not made on the varnish (E) for this reason.

The Falling Needle Viscometer consistently gave viscosity readings higher than the other instruments. Measurements on this instrument probably reflect the maximum structure of previously unsheared samples. This instrument may be particularly useful for measuring viscosities of undisturbed samples of highly thixotropic fluids.

CONCLUSION

Overall, agreement between viscometers became poorer as shear rate decreased. Also, there was less agreement between viscometers during the earlier shear rate increasing portion of the thixotropic loop than during the later shear rate decreasing portion. These trends probably resulted from the sensitivity of the test samples' viscosities to their previous shear history. This sensitivity may be greater at lower shear rates where very weak interactions contribute significantly toward rheological behavior. We suspect that samples with greater thixotropy would show poorer agreement of viscosity measurements between viscometers.

To improve the precision of interlaboratory testing of low-shear rheological measurements, we propose several modifications of the test procedure used in this study. A standardized method for introducing the sample into the viscometer with a preselected time delay between introduction and testing should improve early measurements. The rate of shear rate increase and decrease should also be specified to better control a sample's shear history. Viscosity standards suitable for very low shear rates should be included for calibration purposes. Finally, a standard method should be devised to prevent solvent evaporation.

This study was conducted in an attempt to design a procedure by which low shear viscosity data from different instruments could be compared. With further work to develop a more standardized testing procedure and the use of appropriate calibration standards, this goal should be attainable.

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Low VOC Coatings. General Considerations and Applicability Of Liquid Crystalline Binders

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This report begins with a general discussion of advantages and challenges relating to the formulation of low VOC coatings, introduces the potential for lowering VOCs of air-dry alkyds by incorporation of liquid crystalline (LC) groups, and proceeds to ongoing studies at North Dakota State University on novel LC polymers and oligomers for coatings binders, highlighting the studies on air-dry alkyds and acrylic lacquers. The results of these studies demonstrate that LC binders form stable nonaqueous dispersions, which make them potentially attractive for low VOC coatings applications (as well as for reducing oven-sagging of baked coatings). The results further establish that LC binders provide unusual combinations of hardness and flexibility, together with good adhesion and fast dry (in the case of air-dry alkyds)—properties which are unattainable with corresponding amorphous binders.

GENERAL CONSIDERATIONS

Reduction of solvent levels in coatings is an attractive concept, obviously, both from ecological and, particularly, economical standpoints. A major requirement is reduction of binder viscosity, which may be accomplished by lowering MW and/or glass transition temperature (T_g) of the binder. However, this approach is accompanied by substantial challenges.

Lower MW (or T_g) binders require higher functionality, i.e., lower equivalent weight (EW) of reactive groups, to build-up the MW (or increase T_g) and to achieve desirable film properties. However, the utilization of lower equivalent weight binders tends to narrow the cure window,[1] i.e., the range of bake temperatures and times within which the paint has acceptable film properties. Furthermore, reactive groups (e.g., hydroxyl groups) tend to be polar and to participate in intermolecular interactions, such as H-bonding, which tends to increase viscosity. This counteracting effect limits the potential reduction of viscosity by MW (T_g) reduction.

The polarity of reactive groups also tends to increase surface tension of binders, which promotes the appearance of surface tension-related application defects, such as craters.

The utilization of lower MW binders results in less viscosity increase in spray application, which tends to promote sagging on vertical parts. Furthermore, the higher binder (and functionality) concentration results in a stronger viscosity dependence on temperature, which may be attributed to intermolecular interactions, such as H-bonding, and tends to promote oven-sagging. These factors narrow the temperature window for proper application.

Factors affecting viscosity of high-solids coatings and design considerations have been reviewed, including: oligomer-related effects, such as MW and T_g, MW distribution, and functional group content; solvent-related effects, such as solvent-oligomer interactions, T_g reduction by solvent, concentration, and solvent viscosity; temperature effects; and pigmentation effects.[2]

Aside from challenges relating to application viscosity, low VOC coatings tend to exacerbate the general difficulty of maximizing ambient-stability, i.e., shelf- and pot-life, while minimizing the time and/or temperature for cure. As EW decreases (dictated by decreasing MW), and solvent levels decrease (to lower VOCs), the concentra-

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Table 1—Characterization of PHBA Grafted (G) and Random (R) Alkyds and Air-Dry Films

Alkyd	%PHBA (n)[a]	T_g °C	Viscosity (ps)[b]	Dry-Time	Pencil Hardness	Rev. Impact[c]	Acetone Rubs
R1	15	−23	5.3	5 hr	HB	80	3
G2	15 (1.1)	−20	6.3	7 hr	2B	40	5
R2	22	−18	6.6	4.5 hr	HB	45	4
G3	19 (1.6)	−15	7.0	5.5 hr	B	65	6
R3	27	−12	8.1	3.5 hr	H	20	4
G4[d]	28 (2.0)	−10	3.1	1 hr	H	>80	8
G5[d]	— (3.0)	+17	—	5 min	2H	45	8

(a) Average PHBA graft length.
(b) 70 wt% in xylene.
(c) In.-lbs.
(d) Exhibits LC behavior evidenced by DSC and polarizing microscopy. Translucent films.

Table 2—Film Properties of Amorphous (AM) Acrylic and Corresponding LC Acrylic Lacquers

Acrylic	Backbone M_n[a]	T_g (°C) AM	T_g (°C) LC[b]	Pencil Hardness AM	Pencil Hardness LC	Reverse Impact AM	Reverse Impact LC
MMA/BA/AA							
27/68/5	14,900	−9	−2	sticky	H	<10	70
27/68/5	28,500	−8	−4	sticky	H	30	80
49/46/5	39,500	10	—	HB	—	40	—
MMA/BA/HEMA[c]							
36/59/5	15,100	0	4	sticky	2H	<10	70
36/59/5	28,200	2	5	2B	2H	20	80

(a) Size exclusion chromatography.
(b) Ca. 5 PHBA groups/COOH.
(c) The LC acrylics possess a flexible spacer between the backbone and LC group.

tion of functional groups increases. Since reaction rates are proportional to functional group concentration, reaction rates during storage will necessarily increase, thereby decreasing shelf- or pot-life. Thus, the effectiveness of latent curing agents is more critical in low VOC coatings.[3]

Design of specific resin systems for high-solids coatings, including epoxides, urethanes and thermosetting acrylics and polyesters, has been the subject of numerous publications and patents.[4] A potential formulating advantage of high-solids coatings, becoming increasingly more apparent, is the greater compatibility of lower MW oligomers. This realization has resulted in effective blending of oligomers, including the same generic types, such as low and high T_g (i.e., soft and hard) polyesters, as well as different generic types, such as acrylics with polyesters and/or with urethanes to achieve unique combinations of properties.

A particularly challenging area is the design of high-solids, air-dry alkyd coatings. Important characteristics of air-dry alkyds are dry-to-touch and through-cure times. Conventionally, dry-to-touch (or lacquer-dry) is achieved by solvent evaporation, whereas through-cure is achieved by oxidative crosslinking. Even in conventional (low-solids) alkyds, there is a delicate balance in achieving both desirable characteristics in that factors which promote dry-to-touch, such as short oil-length, and high T_g (e.g., styrenated alkyds) tend to slow through-cure.

This delicate balance is further complicated, obviously, by lower solvent levels and the need for lower MW and/or lower T_g resins in higher-solids alkyds. One approach to obviate this dilemma is the incorporation of a dual-cure mechanism in which dry-to-touch by solvent evaporation is complemented by oxidative crosslinking; and through-cure is achieved by anaerobic crosslinking, utilizing methacrylated oligomers and reactive diluents.[5]

LIQUID CRYSTALLINE (LC) ALKYDS

An alternative approach for high-solids alkyds is incorporation of LC (i.e., mesogenic) groups on the alkyd, together with fatty acids (FA), in which case the dry-to-touch stage by solvent evaporation may be complemented by association of the mesogenic groups.[6] The reversible mesogenic associations (i.e., physical crosslinking) might not inhibit O_2 permeability and thereby allow conventional, oxidative crosslinking to provide through-cure.

Alkyds were prepared from phthalic anhydride (PA), linoleic acid (LA), and trimethylol propane (TMP) by a procedure utilizing dicyclohexyl carbodiimide (DCC).[7] Synthesis of LC-grafted alkyds was accomplished by reacting the free hydroxyl groups with succinic anhydride (or with terephthalic acid), followed by grafting with p-hydroxy benzoic acid (PHBA) groups, utilizing the DCC procedure. As model compounds, alkyds with equivalent amounts of randomly incorporated PHBA groups were prepared by reacting PA, LA, and TMP together with PHBA, utilizing the DCC procedure.

Characterization of grafted (G) and random (R) alkyds is provided in *Table* 1. Grafted alkyds G2-G4 were prepared using succinic anhydride in the previously mentioned procedure, whereas G5 was prepared using terephthalic acid.

The viscosity (70% wt solids in xylene) of the random alkyds (R1-R3) increases monotonically with increasing wt% PHBA, as shown in *Table* 1. In contrast, the graft alkyd G4 exhibits lower viscosity than G3, although G4 contains a higher %PHBA. Whereas G2 and G3 are soluble in xylene, G4, as well as G5, form stable nonaqueous dispersions (NADs) which result in lower viscosity. In contrast to G2 and G3, G4 and G5 also exhibit LC behavior as determined by differential scanning calorimetry (DSC) and polarizing microscopy. Apparently, a minimum average PHBA graft length of about two units is required for LC behavior. The formation of stable NADs with the LC alkyds is a potential formulating advantage for providing low VOC coatings.

Although not provided in the table, random alkyds R1-R3 have similar M_n and M_w values of ca. 1650 and 2600, respectively. Graft alkyds G2, G3, and G4 exhibit M_n values of ca. 1600, 1700, and 1900, respectively, and M_w values of ca. 2400, 2700, and 2900, respectively.

Film properties of the air-dry alkyds are also provided in *Table* 1. As shown, the LC alkyds (G4 and G5) exhibit the lowest dry-times. G5 exhibits the remarkably low dry-time of 5 min; whereas G4 exhibits more favorable reverse impact. These results provide support for the idea that dry-time may be reduced by mesogenic (LC) associations. The results also demonstrate that through-cure is not sacrificed, as measured by solvent-resistance. All films exhibited 100% cross-hatch adhesion to untreated rolled steel.

Thus, LC alkyds provide advantages of lower viscosity by formation of stable NADs, shorter dry-to-touch times, as well as harder and tougher films. There do not appear to be either application or film property advantages for the amorphous grafted alkyds G2 and G3, relative to the corresponding random alkyds, R1 and R2.

LIQUID CRYSTALLINE ACRYLIC LACQUERS

Acrylic lacquers were used as a commercially-important class of automotive topcoats from the mid-1950s to the early 1970s. (Note that the term lacquer is used here to denote cure simply by solvent evaporation.) However, satisfactory mechanical properties required M_n values of ca. 40,000 or more which, in turn, necessitated low solids (ca. 12 vol%) to achieve suitable spray viscosity. Within the context of this report, the relevant question is: Can LC associations compensate for lower MW? That is, can LC acrylics with MWs substantially lower than 40,000 provide satisfactory film properties as lacquers and also be applied at substantially higher solids?[8]

LC acrylics were prepared from conventional carboxy-functional acrylics, produced by free radical polymerization of methyl methacrylate (MMA), butyl acrylate (BA), and acrylic or methacrylic acid (AA or MAA). PHBA groups were directly grafted to the acrylic backbone at the carboxylic acid sites by the DCC procedure, previously described.

Alternatively, hydroxy-functional acrylics, produced by free radical polymerization of MMA, BA, and hydroxyethyl methacrylate (HEMA), were first made carboxy-functional by reaction with succinic anhydride and secondly reacted with PHBA (by the DCC procedure) to introduce the LC chains. This procedure results in a flexible spacer (about 10 atoms) between the acrylic backbone and the LC chains.

A comparison of film properties of amorphous (AM) and corresponding LC acrylic lacquers is provided in *Table* 2.

As shown in *Table* 2, the LC acrylics with M_n values of ca. 15,000 and 28,000 exhibit substantially better film properties than the corresponding AM acrylics. The only AM acrylic which provides films with measurable hardness and reverse impact possesses an M_n of 39,500.

Furthermore, lower VOC coatings can be formulated with the LC acrylics, since they form stable NADs. For example, the MMA/BA/HEMA LC acrylic, shown in *Table* 2, exhibits shear viscosity (10^4 s^{-1}) of ca. 2.0 ps at about 48 wt% solids in methyl isobutyl ketone (MIBK), whereas the viscosity of the corresponding AM acrylic at 48 wt% solids in MIBK is 3.0 ps.

The substantially improved hardness coupled with flexibility of the LC acrylic lacquers suggests that mesogenic (LC) associations may also complement crosslink density without the corresponding sacrifice in flexibility, which generally decreases as crosslink density increases. This prediction has been verified in studies on thermosetting LC acrylics, crosslinked with etherified melamine formaldehyde resins. Notably, both increased hardness and flexibility were achieved only when crosslink density and backbone T_g of the thermosetting LC acrylics are relatively low.[9]

CONCLUSIONS

The results establish that liquid crystalline (LC) coatings binders provide unusual combinations of hardness and flexibility, together with good adhesion and fast dry (in the case of air-dry alkyds). The formation of stable NADs with LC binders makes them potentially attractive for low VOC coatings applications. Furthermore, preliminary studies indicate that viscosity increases substantially on heating, resulting from dissolution of the LC binders, which is a potentially attractive property for reducing oven-sagging of baked coatings.

Many questions come to mind with regard to LC coatings, including corrosion resistance, weatherability, hydrolytic stability, pigmentation, and cost. The established positive features of LC coatings certainly warrant continuing studies in these areas.

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Dissolution Rates of Polymers And Copolymers Based on Methyl, Ethyl, And Butyl Methacrylate

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The rate of dissolution (DR) of thin (1 μm) films of various methacrylate polymers was measured using laser interferometry. The polymers were all of high ($M_n > 600 \times 10^3$) molecular weight and included homopolymers of methyl methacrylate (MMA), ethyl methacrylate (EMA), and n-butyl methacrylate (BMA), as well as copolymers of MMA with EMA and with BMA. Glass transition temperatures (T_g) estimated by differential scanning calorimetry (DSC) ranged from 36°C [poly (n-butyl methacrylate)] (PBMA) to 115°C [poly (methyl methacrylate)] (PMMA). Films were applied to silicon wafers by conventional spinning and baking. The DRs in methyl isobutyl ketone (MIBK) at 30°C ranged from 0.042 μm/min (PMMA) to c. 150 μm/min (PBMA). Activation energy, E_a, in the limited span of 20-40° decreased as T_g decreased. In agreement with other workers, E_a for PMMA was 25 kcal/mol. However, the E_a dropped almost to half that value for poly (ethyl methacrylate) (PEMA) and for BMA-rich copolymers.

INTRODUCTION

The dissolution rate (DR) of thin films of organic polymers is a critical parameter in microlithography. The difference in DR between irradiated and unexposed film (the resist) permits the production of a polymer mask or stencil through which the various operations of doping, insulating, and metallizing can be carried out on the surface of a silicon wafer. The stencil acts in an analogous fashion to the stencil in another, more familiar, form of lithography—silk screening. For some years, poly (methyl methacrylate) (PMMA) has been regarded as a standard material for thin films in which sub-micrometer patterns are drawn by scanning electron beams. PMMA is a positive-working resist material in that it becomes more soluble on irradiation through the process of random chain scissioning.

Because of PMMA's importance, it is instructive to measure the effects of variations in structure on DR. Many a commercial "PMMA" is, in fact, a copolymer. It was the extreme variability of DRs found when PMMAs from several industrial sources were compared that led to the present study. Polymers and copolymers of methyl, ethyl, and n-butyl methacrylate were examined. The abbreviations MMA, EMA, and BMA are used for the three monomers.

EXPERIMENTAL DETAILS

Polymers were prepared by bulk polymerization using 0.05 g of 2,4-dichlorobenzoyl peroxide in 20 mL of monomer or monomer mixture. After 24 hr at 60°C, the glassy polymer (high conversion) was recovered, dissolved in acetone, precipitated by addition of water, and dried. All molecular weight measurements were made by size exclusion chromatography [gel permeation chromatography (GPC)]. A Waters Model 201 HPLC was used with four μ-Styragel columns having nominal pore diameters of 500, 10^3, 10^4, and 10^5 Å. The eluting solvent was tetrahydrofuran (THF) pumped at 2 mL/min. PMMA standards (Polymer Laboratories Ltd.) were used for calibration so the molecular weights are PMMA equivalents (*Table* 1). Polydispersity of the recovered polymers varied only over a narrow range (*Table* 1).

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Table 1—Characterization of Methacrylate Homopolymers And Copolymers

Polymer Composition (wt %)			Molecular Weight			T_g (DSC)
MMA	EMA	BMA	M_n	M_w	M_w/M_n	°C
100	0	0	690	1,470	2.13	115
75	25	0	642	1,360	2.12	98
50	50	0	778	1,600	2.06	80
25	75	0	842	1,790	2.13	78
0	100	0	793	1,660	2.09	73
75	0	25	1,020	1,760	1.73	86
50	0	50	681	1,570	2.31	72
25	0	75	800	1,570	1.96	56
0	0	100	621	1,490	2.40	36

Table 2—Dissolution Rates and Activation Energies (PMMA in MIBK)

Polymer Composition (wt %)			Dissolution Rate, μm/min			Activation Energy
MMA	EMA	BMA	20°C	30°C	40°C	kcal/mol
100	0	0	0.0091	0.042	0.147	25.4
75	25	0	0.041	0.19	0.48	22.5
50	50	0	0.22	0.76	1.79	19.2
25	75	0	0.81	2.4	6.3	18.6
0	100	0	2.8	7.3	16.4	16.2
75	0	25	0.19	0.74	1.55	19.0
50	0	50	3.2	8.6	18.4	16.0
25	0	75	26	61	115	13.5
0	0	100	>70	>150	>230	c. 11

Glass transition temperatures (T_g) were estimated from DSC traces. The solvent used in the dissolution measurements was methyl isobutyl ketone (MIBK).

The laser interferometer used for DR measurement has been described previously.[1,2] In essence, the reflected laser light intensity is monitored during polymer dissolution. The sinusoidal oscillations give a direct measure of the index of refraction of the film and its rate of dissolution. For the present study, a 2 mW unpolarized HeNe laser (Spectra Physics Model 102-4) with wavelength of 632.8 nm was directed horizontally towards a vertically mounted wafer with an incident angle of 10°. The reflected light was collected by a silicon photodiode with a relatively large active area in order to minimize sensitivity to apparatus movements. A transimpedance amplifier with variable gain converted the photocurrent to a voltage signal proportional to the light intensity. For some of the work, a chart recorder with adjustable chart speed was convenient. For the rapidly-dissolving systems, it was more satisfactory to use an IBM PC/XT computer equipped with a Data Translation DT-2801 12 bit A/D converter. A commercial software package, Asystant+® (Macmillan Co.), was found to facilitate acquisition, storage, manipulation, and plotting of the data. An example of the computer-recorded signal is given in *Figure* 1. The thickness period $\underline{d}$ is given by [2]:

$$2\,\underline{d} = \lambda/(n_2^2 - n_1^2 \sin^2\theta_1)^{1/2} \quad (1)$$

where λ is the wavelength of the laser light, n_2 is the index of refraction of the polymer film, n_1 is the index of refraction of the solvent, and θ_1 is the incident angle of

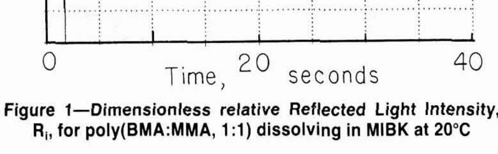

Figure 1—Dimensionless relative Reflected Light Intensity, R_i, for poly(BMA:MMA, 1:1) dissolving in MIBK at 20°C

the beam. The DR is simply the ratio of $\underline{d}$ to the time per cycle in the reflected light trace.

Polymer films were coated from 4% solutions in chlorobenzene onto 3-in. diameter silicon wafers using a Headway Research Model EC-101D spinner. A spinning speed of 1,600 rpm was used to produce approximately one μm-thick films. After spin coating, the polymer films were baked. Baking is usually done above the T_g of the polymer and serves to remove residual solvent and to anneal stresses in the film caused by the spin-coating step. The standard cycle used for all the materials was 1 hr at 150°C in an air-circulating oven followed by a slow cooling to about 70°C over a period of 30 min, also in the oven.

RESULTS AND DISCUSSION

The thermograms of the various copolymers were interpreted to give values of the T_g for the materials (*Table* 1). The results for the homopolymers are in reasonable agreement with literature reports. As usual, transition temperatures from DSC tests are 5-10° above those obtained by dilatometry. The copolymer results are internally consistent. All the copolymers form clear films indicating no obvious inhomogeneity. Indeed, none is to be expected since the relative reactivity ratios are very near to unity for these randomly polymerized systems.

All the polymers [except poly (n-butyl methacrylate) (PBMA)] exhibited the well-behaved dissolution pattern of PMMA. The reflected light traces were almost perfectly sinusoidal and the wafers retained no residue of polymer after dissolution. As an example, the dissolution trace for a 1:1 MMA:BMA copolymer as acquired directly and stored in an IBM-PC can be seen to be quite regular (*Figure* 1). PBMA itself was rather difficult to characterize since it dissolved so rapidly. Because the polymers differed slightly in molecular weight, the DR for each was adjusted to a reference value of M_n = 700,000. In the high molecular weight region, Cooper[3] had found that the DR varied with the M_n to the −0.23 power for PMMA.

$$(DR)/(DR^*) = [(M_n^*)/(M_n)]^{0.23} \quad (2)$$

where a reference dissolution rate and molecular weight are denoted by asterisks. For an M_n of 842,000, the adjustment amounts only to about 4%. For an M_n of 642,000, it is about 2%. These are minor factors com-

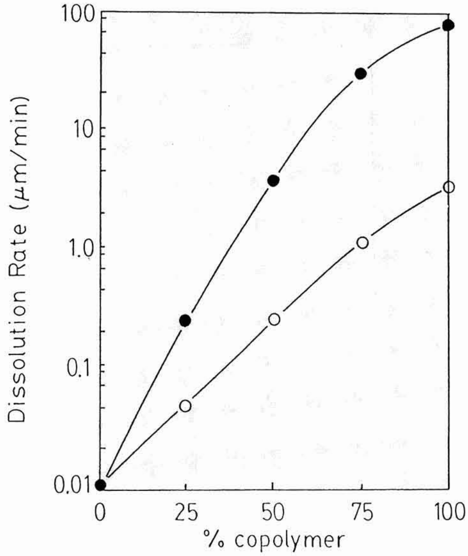

Figure 2—Dissolution rate for copolymers of MMA (adjusted to M_n = 700 × 10^3). ○—EMA; ●—BMA

pared to the differences found with composition. The polydispersity was almost the same for all, so no adjustment was made for it.

DR results for all the polymers in MIBK at 20°C are summarized in *Figure* 2. The transition with composition is smooth, but not linear. The actual rate for PBMA is less certain than for the others since it dissolved so rapidly. The variability in DR of commercial (nominally) MMA polymers can be interpreted in terms of the copolymer results. Addition of only 5% BMA or 10% EMA to an MMA polymer can almost double the DR. With 25% BMA, a copolymer dissolves about 25 times faster than the PMMA of the same molecular weight.

Using published values of intrinsic viscosity parameters, one can estimate a kind of thermodynamic goodness criterion for the ketone solvent and the various polymers. Data are available[4] for the Mark-Houwink parameters K and a for the intrinsic viscosity [η] of PMMA, PBMA, and poly (ethyl methacrylate) (PEMA) in 2-butanone at 25°C.

$$[\eta] = K(M_v)^a \tag{3}$$

It is to be expected that dissolution in MIBK would parallel that in butanone at least to some extent. The K values are 7.1, 2.83, and 9.7 (all times 10^{-5} dL/g) for the three homopolymers, respectively. In the same order, the exponents on the molecular weight are 0.72, 0.79, and 0.68. Using these numbers, intrinsic viscosities for a molecular weight of 700,000 are again in the same order, 1.15, 1.17, and 0.92 dL/g. These numbers are close enough to each other to make it seem unlikely that the faster dissolution of PBMA could be attributed to MIBK being a superior solvent in the thermodynamic sense.

An explanation which might be offered lies in the lower T_g of the copolymers of MMA. This cannot be the whole answer as we can see by considering other experiments in which T_g was varied. In this test, a 1:4 mixture of poly(epichlorohydrin):PMMA was found to dissolve in methyl ethyl ketone at 30°C; about nine times as fast as PMMA. For this blend, the T_g of the mixture is about 40°C measured by DSC.[5] This result can be compared with, say, 75% BMA copolymer with a similar T_g but which dissolves about 2,000 times faster than PMMA.

Table 3—Activation Energies for Dissolution

Polymer	Solvent	Activation Energy kcal/mol	Reference
PMMA	Methyl ethyl ketone	26	(6)
PMMA	Methyl isobutyl ketone	24	(7)
PMMA	Methyl isobutyl ketone	25	(8)
Polystyrene ..	Iodohexane	25	(9)

Poly(epichlorohydrin) is a high molecular weight "plasticizer" with M_n = 300,000. The same effect is noted if a low molecular weight plasticizer is used. When poly(ethylene oxide) (PEO) with an M_n of 3,900 is blended with PMMA, the T_g is depressed to 65°C by 20% PEO.[5] Cooper found that the 20% PEO blend dissolved about 2.5 times as fast as PMMA.[3] This is, once again, a far cry from the increase in rate observed for the BMA and EMA copolymers with a similar T_g. It is rather obvious that alteration of T_g is not by any means the only factor in changing DR.

Another way of considering the differences with T_g is to compare DRs at several temperatures. Dissolution rates were measured at three temperatures (*Table* 2). The effect of changing the dissolution temperature T(DR) and T_g can be seen by plotting DR versus the difference between T(DR) and T_g (*Figure* 3). PMMA actually dissolves faster than the copolymers when the basis of comparison is $[T_g - T(DR)]$.

If the rate is assumed to have an Arrhenius temperature dependence, an activation energy for DR can be calculated (*Figure* 4, *Table* 2). The Arrhenius dependence will generally hold over a narrow temperature range as in this case. The activation energy measured for PMMA matches values previously reported (*Table* 3). Cooper had reported that solvent systems with widely different DRs all had

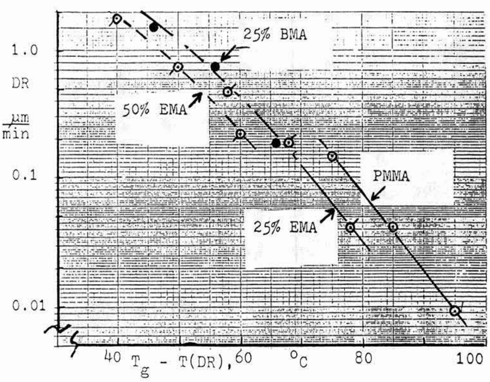

Figure 3—Dissolution rate as a function of difference between T_g and temperature at which dissolution was measured

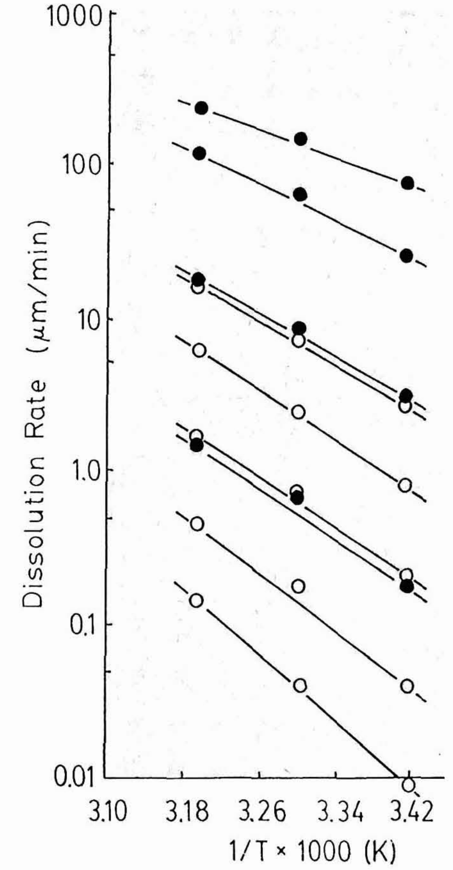

Figure 4—Arrhenius plots for 20, 30, and 40°C. ○—EMA and copolymers; ●—BMA and copolymers (see also *Table* 2)

the same activation energy.[6] However, Ueberreiter had observed a decrease in activation energy near the T_g for PMMA in dimethyl phthalate.[10] He attributed this to separate mechanisms of the dissolution process for the rubbery, glassy, and transition states. Above 80°C, the activation energy he reported was only about 5 kcal/mole.

It is conceivable that the experimental technique could enter into the picture. Upon immersion of the coated wafer in the solvent, thermal equilibrium is not immediately obtained. Rough calculations of unsteady state heat transfer with reasonable liquid film heat transfer coefficients indicate that the wafer should be within 1°C of the solvent temperature within a few seconds of immersion. If we assume that the liquid film coefficient h is controlling, a simple energy balance[11] relates the temperature of the wafer [T(w)] to its original temperature [T(o)], and that of the solvent [T(s)] at any time (t) by the density (ρ), specific heat (c), and thickness (z) of the wafer:

$$2.303 \log \{[T(s) - T(o)]/[T(s) - T(w)]\} = ht/(z\rho c) \quad (4)$$

For the silicon wafers employed, z = 0.36 mm and ρc = 1.65 J/cm^{3}K. A "worst-case" calculation assuming a liquid film heat transfer coefficient of 570 W/m$^{2\circ}$K (100 Btu/h, ft, °F in engineering units) gives a time of 2.2 sec for 90% attainment of equilibrium. Experimental evidence of changing temperature would be a change in DR as the film dissolves. In fact, there is no discernible change in the periodicity of the sinusoidal traces even when films dissolve completely in less than a minute.

CONCLUSIONS

Copolymers of MMA with EMA and BMA dissolve more rapidly than PMMA more or less in proportion to the monomer content. Neither the thermodynamic "goodness" of the solvent nor the decreased interval in temperature between T_g and dissolution temperature seem sufficient to explain the differences.

ACKNOWLEDGMENTS

This work was supported in part by the Office of Naval Research. The cooperation of the National Nanofabrication Facility at Cornell (with sponsorship by the National Science Foundation) also is acknowledged.

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BALTIMORE .... APR.

"Effects of Dispersion"

The Nominating Committee proposed the following slate of officers for 1989-90: Vice President—Gary Morgereth, of McCormick Paint Works Co.; Secretary—Victoria L. Kram, of Lenmar, Inc.; and Treasurer—Mary Lou Spurrier, of SCM Chemicals, Inc.

Current Vice President Donald Hilliard, of Unocal Chemicals Div., will assume the role of Society President for 1989-90.

Society member Mary Somerville, of Bruning Paint Co., was the meeting's speaker. Ms. Somerville discussed the "EFFECTS OF DISPERSION ON COATINGS PERFORMANCE."

A comparison of various dispersion times, ranging from 3 to 20 minutes, and the different effects they have on the physical properties of latex flat, latex semigloss, alkyd flat, and alkyd semigloss were discussed.

The speaker used the Gugenheim Equation to optimize the grinding paste, and talc, silica, and calcium carbonate were used as the extender pigments.

Q. What is the particle size difference between talc and calcium carbonate?

A. They are approximately the same size.

GARY MORGERETH, *Secretary*

BIRMINGHAM .... MAR.

"Coil Coatings"

A 25-Year Pin was presented to J.R. Bourne, of Mebon Ltd., for his years of dedicated service to the Club.

Garnett C. Simmons, of Becker Paints Ltd., presented a talk on "COIL COATINGS." Dr. Simmons is a member of the Birmingham Club.

The speaker used slides to highlight the various outlets for precoated strip. He discussed the many advantages of precoated strip including the environmental considerations at the users end.

Dr. Simmons also talked about various types of coatings and their end uses. The mechanical properties, chemical resistance, and weathering required for each particular application were highlighted.

According to the speaker, the number of companies engaged in the manufacture of coil coatings is relatively small (there are only six large coil coaters in addition to British Steel in the United Kingdom).

The relationship between coating manufacturers and their customers is close because quality control is of the utmost importance, stated the speaker. In conclusion, Dr. Simmons said the coil coatings industry could best be described as fast and furious.

Q. The Swedish are actively seeking solvent-free systems. What is the position in the United Kingdom?

A. Contingency plans are in hand but as of yet there is no demand. The Swedish are looking at water-based systems, the French at powder, and the United Kingdom at high-solids materials.

Q. Does quality control present a problem considering the nature of a coil coating plant?

A. Yes. But standardization of procedures lessens the problem.

G.W. JENKINS
Acting Secretary

CDIC..................... MAR.

"Paint and Coatings Filtration"

Officers nominated for 1989-90 are: President—N. Jay Huber, Jr., of Paint America Co.; Vice President—W.E. "Buddy" Whitlock, of Ashland Chemical Co.; Secretary—James E. Flanagan, of Flanagan Associates, Inc.; and Treasurer—Jon A. Anderson, of Ashland Chemical Co.

President Carolyn L. Tully, of Sun Chemical Corp., presented Past-President Andrew Nogueira, of Mayco Colors, with his Past-President's Pin and honored him for his long and dedicated service to the Society.

The meeting's technical speaker was Rudolph Marosher, of M&M Machine, Vorti-Siv. Division. His topic of presentation was "FILTRATION OF PAINT AND COATINGS."

The educational speaker was Lee Evans, Litigation Attorney for the Ashland Chemical Co., who gave a talk on "PRODUCT LIABILITY."

W.E. WHITLOCK, *Secretary*

CDIC..................... APR.

Past-Presidents' Night

Twenty-two Society Past-Presidents attended Past-President's Night and were honored by a program presented by Federation Honorary Member Lewis P. Larson. Those in attendance included: Nelson Barnhill, Robert Broerman, Robert A. Burtzlaff, Thomas C. Fetterman, William J. Frost, Fred Haniewich, Bernard J. Hegman, Bill M. Hollifield, William C. Kentner, Lewis P. Larson, William Mirick, Elmer Moerschel, Ralph Mueller, Andrew Nogueira, Fred Petke, Harry Poth, Joseph Reckers, Lloyd J. Reindl, Atlee Robinson, George C. Schutte, Joseph W. Stout, and Wally Ziegler.

William Mirick, of Battelle Columbus Labs., gave an overview of the Society

CDIC PAST-PRESIDENTS—Seated (l-r): Harry Poth, Robert Broerman, Fred Haniewich, William C. Kentner, Lewis P. Larson, Atlee Robinson, Lloyd J. Reindl, and Thomas C. Fetterman. Standing (l-r): Bill M. Hollifield, Ralph Mueller, Fred Petke, William J. Frost, Robert A. Burtzlaff, William Mirick, Nelson W. Barnhill, Andrew Nogueira, Joseph Reckers, Joseph W. Stout, Wally Ziegler, Elmer Moerschel, Bernard J. Hegman, and George C. Schutte

Constituent Society Meetings and Secretaries

BALTIMORE (Third Thursday—Snyder's Willow Grove, Linthicum, MD). GARY MORGERETH, McCormick Paint Works, 2355 Lewis Ave., Rockville, MD 20851.

BIRMINGHAM (First Thursday—Strathallen Hotel, Birmingham, England). D.A.A. WALLINGTON, Ferro Drynamels Ltd., Westgate, Aldridge, West Midlands, England WS9 8YH.

CDIC (Second Monday—Sept., Dec., Mar. in Columbus; Oct., Jan., Apr. in Cincinnati; and Nov., Feb., May in Dayton). W.E. "BUDDY" WHITLOCK, Ashland Chemical Co., P.O. Box 2219, Columbus, OH 43216.

CHICAGO (First Monday). KARL E. SCHMIDT, Premier Paint Co., 2250 Arthur Ave., Elk Grove Village, IL 60007.

CLEVELAND (Third Tuesday—meeting sites vary). RICHARD J. RUCH, Kent State University, Dept. of Chemistry, Kent, OH 44242.

DALLAS (Thursday following second Wednesday—The Harvey Hotel, Dallas, TX). RHONDA MILES, Union Carbide Corp., 2326 Lonnecker Dr., Garland, TX 75041.

DETROIT (Second Tuesday—Ukrainian Cultural Center, Warren, MI). LIANA CALLAS ROBERTS, A.T. Callas Co., 1985 W. Big Beaver, Suite 308, Troy, MI 48043.

GOLDEN GATE (Monday before third Wednesday—Alternate between Francesco's in Oakland, CA and Holiday Inn in S. San Francisco). JACK DUIS, Pacific Coast Chemical, 2424 Fourth St., Berkeley, CA 94710.

HOUSTON (Second Wednesday—Look's Sir-Loin Inn, Houston, TX). MICHAEL G. FALCONE, International Paint (USA) Inc., 17419 Little Shoe Ln., Humble, TX 77396.

KANSAS CITY (Second Thursday—Cascone's Restaurant, Kansas City, MO). MARK ALGAIER, Hillyard Chemical, P.O. Box 909, St. Joseph, MO 64501.

LOS ANGELES (Second Wednesday—Steven's Steak House, Commerce, CA). JAMES D. HALL, Sinclair Paint Co., 6100 S. Garfield Ave., Los Angeles, CA 90040.

LOUISVILLE (Third Wednesday—Executive West Motor Hotel, Louisville, KY). JAMES SIMPSON, Reliance Universal, Inc., Resins Div., 4730 Crittenden Dr., P.O. Box 37510, Louisville, KY 40233.

MEXICO (Fourth Thursday—meeting sites vary). GERARDO DEL RIO SEC, G.B.W. De Mexico, S.A., Poniente 116 No. 576, Nueva Industrial Vallejo, 02610 Mexico, D.F., Mexico.

MONTREAL (First Wednesday—Bill Wongs Restaurant, Montreal). ROBERT BENOIT, NL Chemicals Canada Inc., 4 Place Ville-Marie, Ste. 500, Montreal, Que., H3B 4M5 Canada.

NEW ENGLAND (Third Thursday—Sheraton, Lexington, MA). ARTHUR LEMAN, Samuel Cabot Co., 100 Hale St., Nebt, MA 01950.

NEW YORK (Second Tuesday—Landmark II, East Rutherford, NJ). ROGER P. BLACKER, Whittaker, Clark & Daniels, Inc., 1000 Coolidge St., So. Plainfield, NJ 07080.

NORTHWESTERN (Tuesday after first Monday—Jax Cafe, Minneapolis, MN). TERRY STROM, Ti-Kromatic Paints, Inc., 2492 Doswell Ave., St. Paul, MN 55108. WINNIPEG SECTION (Third Tuesday—Marigold Restaurant, Winnipeg). EDWIN R. GASKELL, Guertin Bros. Coatings & Sealants Ltd., 50 Panet Rd., Winnipeg, MB, R2J OR9 Canada.

PACIFIC NORTHWEST (PORTLAND SECTION—Tuesday following second Wednesday; SEATTLE SECTION—the day after Portland; BRITISH COLUMBIA SECTION—the day after Seattle). JOHN BERGHUIS, NL Chemicals Canada Inc., 3450 Wellington Ave., Vancouver, B.C., V5R 4Y4 Canada.

PHILADELPHIA (Second Thursday—Williamson's GSB Bldg., Bala Cynwyd, PA). CHRISTOPHER H. HUHN, Loos & Dilworth, Inc., 61 E. Green Ln., Bristol, PA 19007.

PIEDMONT (Third Wednesday—Ramada Inn Airport, Greensboro, NC). GARY L. WATERS, Sadolin Paint Products, Inc., P.O. Box 669, Walkertown, NC 27051.

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ROCKY MOUNTAIN (Monday following first Wednesday—Holiday Inn North, Denver, CO). BRUCE REHMANN, Komac Paint, 1201 Osage St., Denver, CO 80204.

ST. LOUIS (Third Tuesday—Salad Bowl, St. Louis, MO). TERRY GELHOT, Spatz Paint, 1439 Henley Industrial Court, St. Louis, MO 63144.

SOUTHERN (GULF COAST SECTION—third Thursday; CENTRAL FLORIDA SECTION—third Thursday after first Monday; ATLANTA SECTION—third Thursday; MEMPHIS SECTION—bi-monthly on second Tuesday; and MIAMI SECTION—Tuesday prior to Central Florida Section). JAMES R. SALISBURY, Union Carbide Corp., 2043 Steel Dr., Tucker, GA 30084.

TORONTO (Second Monday—Cambridge Motor Hotel, Toronto). GERRY PARSONS, DeSoto Coatings Ltd., 895 Rangeview Rd., Mississauga, Ont., L5E 3E7 Canada.

WESTERN NEW YORK (Third Tuesday—meeting sites vary), MARKO K. MARKOFF, 182 Farmingdale Rd., Cheektowaga, NY 14225.

officers who have served as President of the Federation.

Educational speaker Steve Danker, Golf Pro at The Vineyards, gave a golf presentation to the Society.

W.E. WHITLOCK, *Secretary*

CLEVELAND............. APR.

"Perception of Color"

Long-time Society member Helen Skowronska was elected a Society Honorary Member by those members in attendance.

Nominated for officer positions for 1989-90 are: Vice-President—Richard J. Ruch, of Kent State University; Secretary—Benjamin J. Carlozzo, of Tremco Corp.; Treasurer—Roy A. Glover, of Jamestown Paint & Varnish Co.; Society Representative—Fred Schwab, of Coatings Research Group, Inc.; Assistant Treasurer—Freidun Anwari, of Coatings Research Group, Inc.; and Member-at-Large—Robert K. Schlatzer, of B.F. Goodrich Co. Vice President Ilona Nemes, of Sherwin-Williams Co., will become Society President for 1989-90.

Jacqueline Welker, of PPG Industries, Inc., was the meeting's speaker. She discussed the "BASIC PERCEPTION OF COLOR."

The speaker talked about the perception and stimulus of color and used slides for illustrative purposes. Ms. Welker also touched on color terminology including hue-color, value-light and -dark, and chroma-intensity. She stated that the Monzell System is one system that illustrates this color terminology.

Ms. Welker focused on colorimetry and showed slides depicting the spectra of va ious pigments, pointing out that low concentrations are needed to show variations in the spectra between different samples.

The speaker said that mathematical equations are continually being modified to more accurately represent "average" observations of color by a spectrum of individuals.

Ms. Welker commented on the importance of the light source. She used examples consisting of the same object under different light sources to further illustrate her point.

RICHARD J. RUCH, *Secretary*

KANSAS CITY............ MAR.

Hallmark Tour

Society members toured the Hallmark Card manufacturing plant facilities in Leavenworth, KS, prior to the meeting.

The plant mainly produces gift wrap and paper bags. They are manufactured using line speeds of 800-1500 ft/min.

Approximately seven million pounds of ink are used at the facility in a year. All the inks, except black, are manufactured at the facility and are filtered through one-micron filters. Color matching of the various inks used is accomplished, on the average, in one and one-half hours with a color tolerance of E=0.1

As part of its reduction program, Hallmark's intention is to convert from solvent to water-based inks by the early 1990s.

MARK D. ALGAIER, *Secretary*

LOS ANGELES............APR.

Bosses Night

A moment of silence was observed for Mentis Carrere, Retired, a founding member of Sinclair Paint Company, and Don Carleton, who both died recently.

L. Lloyd Haanstra, of Decratrend Corp., delivered the environmental report. He stated that SCAQMD had approved a 20-year plan to clean up the air. The plan addresses issues as small as backyard barbecues and gas powered lawnmowers. According to Mr. Haanstra, the real message is to anticipate increasingly stricter regulations for the next 20 years.

The talk then shifted to Rule 1113 and the current process of change.

In addition, Mr. Haanstra spoke about Senate Bill 1409, a proposal by Senator Presley on behalf of the paint industry. The bill will create a California Solvents Research Institute to conduct research on and advance the state of low VOC technology.

The speaker for the evening was James W. Joudrey, of Troy Chemical Corp. The New York Society member discussed "RHEOLOGICAL MEASUREMENTS AS A GUIDE TO ADDITIVE PERFORMANCE."

Mr. Joudrey focused on a study in which a series of rheology agents was incorporated into four solvent based systems: conventional air-dry enamel; high-solids air-dry enamel; conventional baking enamel; and high-solids baking enamel. He stated that measurements were made of the relative amount of pigment suspension and the sag resistance of the finished paints. Viscosity measurements were made over a very wide range of shear rates using a Haake Rotovisco 100 Viscometer.

The speaker said the effects of additive addition on application properties were compared to viscometer data. Mr. Joudrey disclosed that definite correlations were observed between low shear rate viscosity measurements and resistance to pigment settling and sagging. In conclusion, it was noted that the differences in the performances of the rheology agents were observed in the four systems evaluated.

Q. Can the viscosity change from 0.2 reciprocal seconds to 0.02 reciprocal seconds be used to predict orange peel effects in a spray formula?

A. That sounds like a new paper to me. That was one of the things we talked about. We did not initially see correlations between the actual data received with the low shear and the flow and leveling properties. We will be looking into that. That is one of the interesting areas. I don't know if anybody has done any work on that yet.

Q. Have you determined that performances of many types of additives are sometimes a function of PVC? Would this technique help screen additive use?

A. Yes. That is part of it. Usually, the type of additive and the PVC together will be a better determinant of the actual performance of the additive at the end. That is a possibility for screening additive use, but when you start to look at individual things like that you can get unbelievable answers to questions. We learned in this particular paper that we wanted to hold the constants as constant as we could and look at only one thing changing at a time. If you start to look at two things changing, your are going to be in real big trouble because you will not know which change caused the difference.

JAMES D. HALL, *Secretary*

LOUISVILLE..............APR.

Election of Officers

Officers elected for the 1989-90 year are, as follows: President—Louis F. Holzknecht, of Devoe Coatings Co.; Vice President—Raymond L. Mudd, of Porter Paint Co.; Secretary—Kris Grauer, of Kurfees Coatings, Inc.; and Treasurer—James Simpson, of Reliance Universal, Inc.

James A. Hoeck, of Reliance Universal, Inc., will continue to serve as the Society Representative to the Federation Board of Directors.

The presentation of 25-Year Pins was made to the following members in attendance: Edward E. Richter, of Blatz Paint Co.; Russell B. Smythe, Retired; and Herb Wilson, of Reliance Universal, Inc. Those members who were not present to receive their awards were: James A. Hoeck, Victor

J. Kurk, and Paul Leary, all of Reliance Universal, Inc.

The meeting's speaker was Rick Lance, Defensive Coordinator for the University of Louisville football team. Mr. Lance talked about how the university was trying to build a football team that could contend for the national championship in 1989 or 1990.

JAMES U. SIMPSON, *Secretary*

NEW ENGLAND .... MAR.

"Computer Controlled Production Plant"

Joseph H. Weinburg, Environmental Affairs Committee Chairman, of Permuthane Coatings, discussed the new VOC regulations in California and the regulations proposed for New Jersey.

The speaker for the evening was Pius Eigenmann, of Buhler-Miag, Inc., who presented a talk on "COMPUTER CONTROLLED PRODUCTION PLANTS FOR INDUSTRIAL PAINTS."

The speaker described Buhler-Miag and the various types of computer-controlled coatings equipment they manufacture including three-roll mills, horizontal bead mills, vertical mills, and high-speed dispersers.

Mr. Eigenmann spoke about the advantages and disadvantages of the various pieces of processing equipment. He noted that horizontal mills are easier to clean than vertical mills; however, vertical mills are better than horizontal mills for handling medium viscosity coatings dispersions (horizontal mills are for lower viscosity dispersions). The speaker stated that a three-roll mill is best for high viscosity coatings dispersions. The importance of type and size of media in each mill was explained.

Slides of a "walk-through" of a modern coatings plant which uses computer-controlled processing equipment were viewed.

Q. Are you able to stop the mixing and check a grind?

A. Yes. Some of the equipment has sampling ports and the equipment can be stopped for sampling at any time.

Q. What is the life expectancy of media in the mills?

A. Media is relatively protected by a coating when it is processing it. Most damage to media occurs when the media is being cleaned and flushed with solvent after processing a coating. Here is when media can rub and damage each other.

ARTHUR A. LEMAN, *Secretary*

PITTSBURGH .... MAR.

"Isoparaffins"

Peter G. Miasek, of Exxon Co., gave a talk on how "ISOPARAFFINS IMPART BENEFICIAL PROPERTIES TO COATINGS THROUGH LOW SURFACE TENSION."

The speaker stated that solvents with lower surface tensions produce coatings with lower surface tensions.

The addition of isoparaffins reduces surface tension in solvent-borne coatings. According to Mr. Miasek, isoparaffin solvents can be used to extend the wet edge time of water-borne coatings and to inhibit foaming. Also, he said isoparaffinic solvents can replace conventional antifoaming agents at lower cost without sacrificing performance properties of the coating.

M. CAROLE STORME, *Secretary*

SOUTHERN.............. APR.

53rd Annual Meeting

This 53rd Annual Meeting of the Society was held at the Hyatt Regency Westshore, Tampa, FL, on April 7.

Federation officers in attendance included President James E. Geiger, of Sun Coatings, Inc., and Executive Vice-President Robert F. Ziegler.

Mr. Ziegler reported on the upcoming 67th FSCT Annual Meeting and 54th Annual Paint Industries Show to be held in New Orleans, LA, on November 8-10. Mr. Ziegler noted that Thad T. Broome, of J.M. Huber Co., is the Host Committee Chairman.

DEDICATED SERVICE—CDIC President Carolyn L. Tully presents Andrew Nogueira with his Past-President's Pin

Mr. Broome announced the Host Subcommittee chairmen: *Spouses' Program*—Gerald A. Mattson, of the University of Southern Mississippi, and his wife Brenda; *Federation Exhibition*—Dan Dixon, of Engelhard Corp.; *Information Services*—Berger G. Justen, of Justen & Associates; and *Program Operations*—Bill Mehaffey, of Mehaffey & Daigle, Inc. Rick Rawle, of Sunbelt Coatings, Inc. is Chairman of the Registration Area Subcommittee.

The following officers were nominated and elected for 1989-90: President—Kenneth W. Espeut, of Jim Walter Research; Vice President—James R. Salisbury, of Union Carbide Corp.; Secretary—Vernon Sauls, of Justen & Associates; and Treasurer—Billy M. Lee, of Chemex Paint & Coatings.

Chairmen from the Atlanta, Central Florida, Gulf Coast, Memphis, and South Florida Sections of the Society reported on attendance at monthly meetings and various program activities.

Environmental Committee Chairman Patricia Nichols, of Du Pont Co., reported that the new solvent tax for Florida is the "hottest" issue at the present time. Ms. Nichols is in the process of contacting the National Paint and Coatings Association and the Florida Paint and Coatings Association and asked that Section Chairmen keep her informed on local environmental issues.

Society member Jack E. Benham, of JB Chemical Coating & Consulting, reported that he is taking a group of people from the coatings industry to China September 24-October 4. The trip has been arranged through the U.S. Exchange Program.

JAMES R. SALISBURY, *Secretary*

BALTIMORE

Active

BRYANT, MILES T.—The Valspar Corp., Baltimore, MD.
HANSEN, DONNA LYNN—The Valspar Corp., Baltimore.
HARVILICZ, CHARLES B.—Jotun Valspar, Baltimore.
LAPETINA, LEONARD A.—The Valspar Corp., Baltimore.
PIERZAKOWSKI, BRUNO J.—The Valspar Corp., Baltimore.
WERNER, RONALD A.—The Valspar Corp., Baltimore.

Associate

HYDE, TIMOTHY S.—Sherex Polymers, Inc., Haddonfield, NJ.

BIRMINGHAM

Active

BRANDON, E.—Industrial Paints (Birmingham) Ltd., Halesowen, West Midlands.
CHOHAN, B.—Birmingham.
COLEMAN, B.J.—Birmingham.
EDDOWES, D.E.—Epsom, Surrey.
JUKES, J.R.—Birmingham.
LEWIS, G.J.—Croda Paints Ltd., Hull.
POPOV, G.T.—Henkel Chemicals, Stourbirdge, West Midlands.
RALPH, MALCOLM L.—Holden Surface Coatings Ltd., Birmingham.
TRUEMAN, C.M.—Carrs Paints Ltd., Birmingham.
WOOTTON, T.E.—Newtown Industrial Paints Ltd., Tamworth, West Midlands.

Associate

KELLY, JEFFREY—NL Chemicals (UK) Ltd., Wilmslow, Cheshire.
SHEEMAN, MICHAEL—K&K Greeff Ltd., Eew Wilmslow, Cheshire.
VIALS, IVOR LESLIE—Gelpke and Bate Ltd., London.

C-D-I-C

Active

DEUTSCHER, ANDREW K.—Yenkin-Majestic Paint Co., Columbus, OH.
HOUSER, K. GREG—Neyra Industries, Inc., Cincinnati, OH.
WOLTERS, MARK A.—BASF/Inmont Corp., Cincinnati.

Associate

HALLEY, ROBERT W.—Neville Chemical Co., Terrace Park, OH.

CLEVELAND

Active

BALSAT, CHRISTOPHER J.—Republic Powdered Metals, Medina, OH.
CHARVAT, ROBERT A.—Engelhard Corp., Beachwood, OH.
DITTMAN-MCBAIN, CARLA B.—The Glidden Co., Strongsville, OH.
KLEMM, GREGORY E.—Spectrum Dispersions, Inc., Ravenna, OH.
KLEMM, TIMOTHY C.—Spectrum Dispersions, Inc., Ravenna.
MODLY, ZOLTAN M.—Engelhard Corp., Beachwood.
MULLEN, LISA M.—Sherwin-Williams Co., Cleveland, OH.
ROSELLE, JOHN G.—Dorn Color Card, Inc., Cleveland.
RUMBERG, JENNIFER L.—Mahoning Paint Corp., Youngstown, OH.
STERBENZ, PAUL J.—Dorn Color Card, Inc., Cleveland.
WOODS, BRIAN M.—Mahoning Paint Corp., Youngstown.

Associate

NEV, ROBERT—Deeks & Co., Inc., Hinckley, OH.

DETROIT

Active

ANDRUS, HOWARD L.—Ronningen-Petter, Portage, MI.
ARONSON, SANDRA ANN—BASF Corp., Hamtramck, MI.
BLODICK, JAMES R.—Durako Paint & Color Corp., Detroit, MI.
DOHERTY, MARK M.—Du Pont Co./Mt. Clemens Coatings, Mt. Clemens, MI.
GERMANY, YRETTE—BASF Corp., Hamtramck.
HALLOCK, YALI F.—BASF Coatings & Inks, Southfield, MI.
KANDOW, LINDA K.—Grow Group, Inc., Troy, MI.
LAMB, DOUGLAS M.—Du Pont Co., Rochester Hills, MI.
LASKOS, DENNIS M.—Kay Screen Printing, Detroit.
NORRID, WARREN S.—Chrysler, Livonia, MI.
PERKINS, DENNIS H.—Akzo Coatings America, Inc., Troy.
RICHARDS, THOMAS S.—Automotive Finishes, Inc., Dearborn, MI.
ROPA, PAUL J.—Dow Corning Corp., Midland, MI.
STECKERT, DEANNA L.—Detrex Corp., Redford, MI.

Vorbeck, Udo W.—BASF Corp., Whitehouse, OH.

Associate

Dershinski, Dave—Kay Auto Graphics, Auburn Heights, MI.
Lindwall, David P.—Shell Chemical, Troy, MI.

HOUSTON

Active

Castellanos, Richard—Monarch Paint Co., Houston, TX.
Jones, Jerry D.—Guardsman Products Inc., Houston.
Massingill, John L.—The Dow Chemical Co., Freeport, TX.
Neville, Gordon H.—Texaco Chemical Co., Bellaire, TX.
Phillips, Charmaine P.—Picco Coatings Co., Houston.
Stephen, Mathew—Vickers Industrial Coatings, Channelview, TX.

Associate

Harkins, James S.—Mat Chemicals Inc., Houston, TX.
Moore, Gary—Arco Chemical Co., Houston.
Summers, Patricia E.—Exxon Chemical Co., Houston.
Walker, Patricia A.—Van Waters & Rogers, Houston.

LOUISVILLE

Active

Johnson, Ronald E.—Devoe & Raynolds Co., Inc., Louisville, KY.
Kleis, Edward J.—Devoe & Raynolds Co., Inc., Louisville.
Roy, George A.—Hi-Tek Polymers Inc., Louisville.
Trice, R. Timothy—Blatz Paint Co., Louisville.

Associate

Roth, David Allen—Mineral Pigments Co., Cincinnati, OH.
Salutsky, Fred—Paragon Distributors, Louisville, KY.
Spanyer, Gary—Evergreen Environmental, Prospect, KY.
Wansik, Michael J.—Skidmore Sales & Dist. Co., Cincinnati.

NEW YORK

Active

Burgos, Jose A.—Chromatic Paint Corp., Stony Point, NY.
Doviak, William C.—Alfa Ink Division, Carlstadt, NJ.
Kolakowski, Michael A.—Hüls America, Piscataway, NJ.
Tilara, Navin K.—Hempel Coatings (USA) Inc., Wallington, NJ.

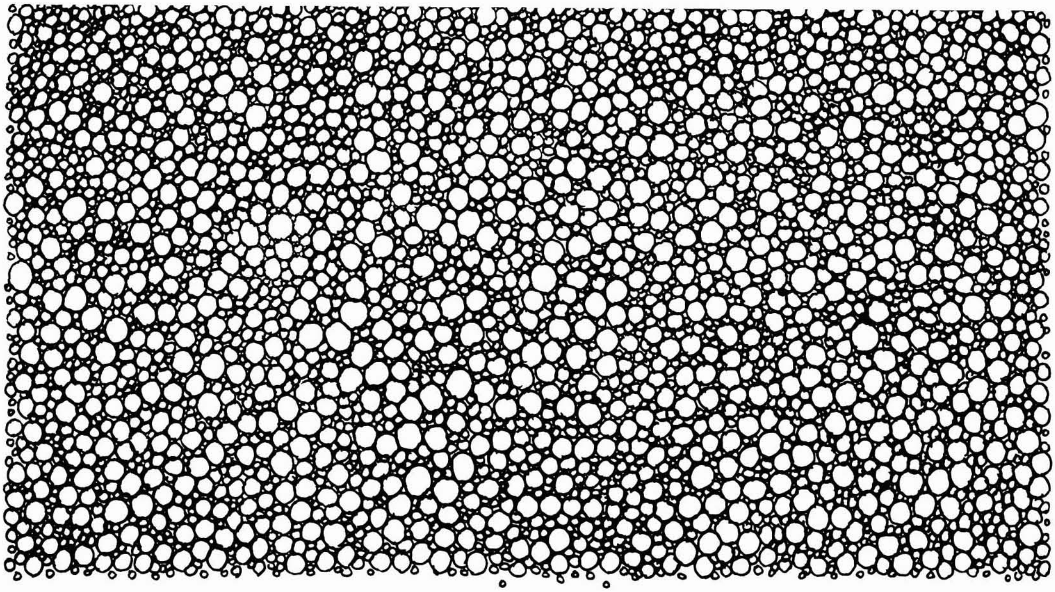
Associate

Cochran, Michael S.—Chemcentral Corp., Boonton, NJ.
Cornelius, Lester E.—Optical Tech. Corp., Long Island City, NY.
Flynn, John P.—Rhone-Poulenc Inc., Princeton, NJ.
Lategano, Charles—Milton Roy/Diano, Parsippany, NJ.
Lawler, James E.—Whittaker, Clark & Daniels, Inc., S. Plainfield, NJ.
Munro, Jack G.—Hi-Tek Polymers, Inc., Basking Ridge, NJ.
Palumbo, Salvatore M.—Harcros Chemical Inc., Holtsville, NY.

NORTHWESTERN

Active

Baab, Bryan L.—Varitronics Systems, Inc., Brooklyn Park, MN.
McGillivray, George D.—Hoffer Coatings, Wausau, WI.
Schwietz, Sue—Varitronics Systems, Inc., Brooklyn Park.
Steuart, Mark R.—Valspar Corp., Minneapolis, MN.



Associate

Lichter, Cathy J.—Dow Chemical USA, Minnetonka, MN.
Martin, Bryon R.—Manville, Monticello, MN.

Educator/Student

Evanson, Kevin W.—North Dakota State University, Fargo, ND.
Gaboury, Scott R.—North Dakota State University, Fargo.
Kuntz, Victoria D.—North Dakota State University, Fargo.

PACIFIC NORTHWEST

Active

D'Souza, Frank P.—Reichhold Ltd., Port Moody, B.C.

Associate

Dorrell, George—Ashland Chemical Co., Portland, OR.
Neff, Jane—Sanncor, Alameda, CA.
Orban, Larry A.—Ashland Chemical Co., Portland.
Tuor, Bill—Pacific Coast Chemical, Boring, OR.

PHILADELPHIA

Active

Del Donno, Theodore A.—Rohm and Haas Co., Spring House, PA.
Ellenberger, Robert W.—Aqualon Co., Wilmington, DE.
Keegan, Donald E.—Lilly Industrial Ctgs., Paulsboro, NJ.
Ziga, Anthony S.—Palmer International, Worcester, PA.

Associate

Dresdner, Michael M.—Factory 875, Zionhill, PA.
Keller, Kimberley A.—C.J. Osborn, Merchantville, NJ.
Penichter, David—W.R. Grace-Davison Div., Baltimore, MD.

PIEDMONT

Active

Broome, Earnest L.—Chemical Coatings Inc., Hudson, NC.
Clark, Gerald B.—Valspar Corp., High Point, NC.
Greenfield, Richard—Valspar Corp., High Point.
Hicks, Phillip D.—Sadolin Paint, Walkertown, NC.
McKee, James T.—Carolina Coatings, Charlotte, NC.
Moody, Keith M.—Eastman Chemical Products, Kingsport, TN.
Muselman, Greg—The Lilly Co., High Point.
Tate, William M.—Van Horn & Metz, Jackson Springs, NC.
Wall, James M.—Sherwin-Williams Co., Greensboro, NC.

Associate

Busche, Jeffrey A.—Texaco Chemical Co., Charlotte, NC.
Gregg, Jimmy Carroll—N L Chemicals, Matthews, NC.
Harris, Mike C.—Southern Color Co., Rural Hall, NC.
Hagaman, Brian A.—Mooney Chemicals, Cleveland, OH.
Owen, Ward Beecher—Chemcentral, Jamestown, NC.
Rogeri, Timothy S.—McCullough & Benton, Inc., Charlotte.
Watts, Dennis R.—Henkel Corp., Lawrenceville, GA.
Wilson, Charles B.—Burks Inc., High Point, NC.

PITTSBURGH

Active

Bartley, Michael L.—Valspar Corp., Pittsburgh, PA.
Bassi, Mitchell B.—Mobay Corp., Pittsburgh.
Bich, George J.—Westinghouse Electric Corp./EMD, Manor, PA.
Dearth, Randall S.—Mobay Corp., Pittsburgh.
Ebbert, Colleen K.—Mobay Corp., Pittsburgh.
Nakano, Kiyoshi—Murata Erie N.A., State College, PA.

Associate

Carlin, H. James—Durr Marketing Assoc., Pittsburgh, PA.

ROCKY MOUNTAIN

Associate

Rezell, Joseph M.—ICI Resins US, Arlington Heights, IL.

SOUTHERN

Active

Allen, Stuart G.—Consultant, Coral Springs, FL.

WESTERN NEW YORK

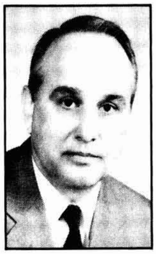
Active

Lutz, William P.—Essex Specialty Products Inc., Jamestown, NY.
Mallwitz, Jayne M.—NL Chemicals Inc., Buffalo, NY.
Mgaya, Alexander P.—NL Chemicals Inc., Cheektowaga, NY.
Moser, John E.—Wood Finishing Supply, Macedon, NY.
Ritchie, John G.—Master Builders Inc., Buffalo.
Waters, Gregory J.—Pierce & Stevens Canada, Fort Erie, Ont.


J.H. Sweet


J.E. Verner


R.J. Wingender


J.W. Brooks

John H. Sweet, Manager of Technical Services for Ashland Chemical Company in Dublin, OH, has been named a 1989 recipient of ASTM's Award of Merit sponsored by Committee D-16 on Aromatic Hydrocarbons and Related Chemicals. The award, and the accompanying honorary title of Fellow of the Society, were established in 1949 to recognize productive service to ASTM, marked leadership, outstanding contributions, or publication of papers.

In addition to his ASTM activities, Mr. Sweet is affiliated with the CDIC Society for Coatings Technology, the American Chemical Society, and the National Association of Solvent Recyclers.

In his new position as Sales Representative with Unichema Chemicals, Inc., Chicago, IL, **James E. Verner** will be responsible for the sale of the company's full line of oleochemical products within the south and lower midwest regions of the country.

John Bress has joined Stamat, Inc., Dallas, TX, in a Marketing/Technical Liaison capacity. He will have direct marketing responsibility for Stamat's customers in Louisiana, east Texas, and selected accounts in Dallas and Houston. Mr. Bress is a member of the Dallas Society.

Jane E. Neff has been named Technical Sales Representative/Western Region for Sanncor Industries, Leominster, MA. She will be responsible for the marketing of the firm's product lines in sales west of the Rockies.

Bringing over 20 years of industrial and consulting experience in strategic and technology management to his new position, **Sushil K. Bhalla** has been named Technical Director/Research and Development for J.M. Huber Corp., Chemicals Division, Havre de Grace, MD. Dr. Bhalla succeeds **Lloyd E. Williams** who is retiring after 29 years with Huber Chemicals.

In addition, **Charles T. Meyer** has joined the staff of Huber as Research Engineer. Prior to joining the firm, Mr. Meyer was employed with the U.S. Department of Energy, Morgantown Energy Technology Center where he was a Research Fellow involved in energy simulation studies in coal-fired gas turbines.

In his new position of Manager of Analytical Services with the Dexter Corporation's Packaging Products Division, Waukegan, IL, **Ronald J. Wingender** will manage the analytical lab's day-to-day operations, staffing and staff performance; budget preparation; equipment purchasing, and technical supervision.

The Mearl Corporation, New York, NY, has announced the addition of two new Area Coordinators in the firm's international sales department, **Jeronima Pilar** and **Bradford Brooker.** Ms. Pilar's primary duties will include a liaison between Mearl's network of agents throughout Latin America, as well as providing customer services and technical support. Mr. Brooker will assume the responsibility of Area Coordinator for Africa, Scandinavia, Comecon (eastern block nations), and will also report on activities in other European countries to the international sales manager.

The appointments of **David G. Decker** as Vice President/Customer Service and **Tom DiCarrado** as Vice President/Operations have been announced by the Macbeth Division of Kollmorgen Instruments Corporation, Newburgh, NY. Mr. Decker joined Macbeth as Director of Product Management in 1983 and became Director of Customer Service two years later. Mr. DiCarrado came to the company as Engineering Manager in 1979 and became Director of Operations in 1984.

Lars Carlson has been named Division Manager/Industrial Coatings Division of H.B. Fuller Co., St. Paul, MN. Mr. Carlson joined the company in 1977 and was Assistant to the President. He most recently served as Division Manager of H.B. Fuller's Monarch Division.

SCM Chemicals, Baltimore, MD, has announced the appointment of **James W. Brooks** as General Manager/Colors and Silica. In this position, Mr. Brooks will be responsible for the planning, direction, control, and execution of all colors and silica business operations, to include manufacturing, marketing/sales, technology, strategic planning, finance, and employee relations. He has been with the firm since 1959.

Akzo Chemicals, Inc., Chicago, IL, has announced the following appointments: **Timothy Saddow**—Sales Representative/Industrial Chemicals Group, East Coast Region; **Alfred Jung**—Business Manager/Petroleum Chemicals for the Fine & Functional Chemicals Group; **Kelly Triplett**—Business Manager for the Fine & Functional Chemicals Group; and **Henry Steinberger**—Senior Account Representative/Detergent-Personal Care Group.

In addition, **Janet R. Tuohy** has been named Director of Purchasing for Akzo Coatings Inc., headquartered in Troy, MI.

FSCT Membership Anniversaries

50-Year

Baltimore

Howard G. Sholl, Federation and Society Honorary Member

Los Angeles

John A. Gordon, Society Honorary Member

Philadelphia

Ralph B. Frazier, Society Honorary Member
Edward Merkle, M.A. Bruder & Sons, Inc.
Eugene H. Ott, Retired

Raymond B. Seymour, of USM, Receives 1989 SPE International Award

Raymond B. Seymour, Distinguished Professor of Polymers Science at the University of Southern Mississippi, has been selected as the recipient of the 1989 SPE International Award (sponsored by the New York Section). Dr. Seymour has spent more than half a century contributing to progress in plastics technology as a teacher, writer, inventor, and researcher. He has invented high-performance plastics (Cadon), high-impact polystyrene, fumed silica filled acrylic dentures, plastic body casts, plastic bonded textiles, vinyl plastics, nylon-reinforced plastics, and plastic oil additives. He played a leading role in the development of commercial processes for producing styrene monomer and polystyrene, butyl rubber, acrylic fibers, welded PVC structures, thermoplastic pipes, and polyurethane foams and coatings.

Dr. Seymour has received more than 40 professional honors and awards, including SPE's Education Award (1982). He is a member of the Plastics Hall of Fame and a Plastics Pioneer. In 1985, Dr. Seymour received the American Chemical Society's Charles Herty Award. He has written more than 1800 scientific reports, primarily in the field of polymer science published in journals throughout the world, he holds 45 U.S. patents and over 100 foreign patents, and he has authored over 30 books. Dr. Seymour has taught at universities in the USSR, Yugoslavia, Czechoslovakia, Trinidad, Australia, Bangladesh, Taiwan, Mexico, and Canada, in addition to more than 100 American universities. He has been a member of SPE since 1944, and is also a member of SPI, ACS, and AIC.

Hitox Corporation of America, Corpus Christi, TX, has appointed **R. Steve Hughes** as Senior Sales Representative. Mr. Hughes will be responsible for product development and management of the company's barium sulfate, zinc oxide, and iron oxide pigment lines. He will be based temporarily out of his home in Tulsa, OK.

Unocal Corporation has named **Austin Byers** General Manager/Marketing & Sales, for its Polymers Business Unit, located in Schaumburg, IL. In his nine years with Unocal, Mr. Byers has also held marketing management positions in both Polymers and Chemicals Distribution.

Pat Tandon, formerly Product Manager for Goodyear Chemical Europe, has been appointed Marketing Manager for thermoplastic modifiers at Goodyear's world headquarters based in Akron, OH. His new responsibilities will include marketing duties in the North American, Far East, and Pacific Rim markets.

USG Corporation, Chicago, IL, has announced the naming of **Samuel D. Constan,** formerly Executive Vice President and Chief Executive Officer of DAP, Inc., to President and Chief Executive Officer of DAP, Inc. Mr. Constan joined United States Gypsum Company in 1961 and has held a variety of management positions of increasing responsibility, including Metal Products General Manager and Director, Marketing Services. DAP, Inc. is headquartered in Tipp City, OH.

Daniel F.X. (Dan) Whitney, a company sales representative for the past eight years, has been promoted to Northeast Regional Sales Manager by Samuel Cabot, Inc., Newburyport, MA.

In addition, two other appointments have been announced: **Tom Daniels**—Sales Representative for Southeastern Massachusetts, and **Richard P. (Rick) Farrar**—Sales Representative for central New England and northeastern Massachusetts.

Ronald C. Whitaker has been named President of The Wheelabrator Corp., Shenandoah, GA, succeeding **Walter R. Young,** who has resigned. Mr. Whitaker previously had been President of North American Operations at Wheelabrator.

The Board of Directors of The O'Brien Corporation, S. San Francisco, CA, recently elected two new officers. **John R. Brvenik** was named Vice President/ Powder Coatings. He joined the firm nine years ago, and most recently served as General Manager of the Powder Coatings Division. He works out of Houston, TX. **Richard T. Hauguel** was elected Assistant Secretary. He has been with O'Brien for 29 years and is located in South Bend, IN.

Also, **Brian J. McCorry** has been promoted to Director of Customer Service for the firm. In his new position, Mr. McCorry will continue to be based in South Bend, IN, and will be responsible for the operation, maintenance, development, and expansion of all customer service functions.

Michael A. Granito has been elected Executive Vice President of the D.H. Litter Co., Inc., New York, NY. He joined the Sales Department of the company in 1969, and has been involved with the marketing of products to the food, pharmaceutical, and cosmetic industries, as well as the paint and coatings industry.

Craig M. Podell has been named Western Regional Manager for Cosan Chemical Corp., Carlstadt, NJ. Mr. Podell will be responsible for the paint, coatings, and plastic industries in the territory west of the Mississippi River.

Tim Storey has been named Field Service Technician for The Ohmart Corp., Cincinnati, OH. He will act as authorized serviceman for new equipment installations, general maintenance, and field service work on the company's line of continuous noncontact web thickness and density, level, weight, and moisture gauges for the process industries. Mr. Storey will be responsible for all of Ohmart's gauge installations located in the Western Region which includes locations west of the Rocky Mountains.

NYCO, Willsboro, NY, has announced that **Michael Rønne-Lotz** has been named Manager—Marketing and Sales, Europe. His responsibilities include the direction of European sales agents, management of customer services, new product marketing for Europe, and technical assistance. Mr. Rønne-Lotz has been the company's Sales Agent in Scandinavia for 15 years.

Robert G. Brokaw has been appointed Sales Service Manager of PDI, a business unit of ICI Americas, Inc., Wilmington, DE. His duties include technical services, where Mr. Brokaw will oversee the application of PDI products at customer locations. He has been with PDI for 28 years, having previously served as Production Manager and Color Matching Laboratory Manager.

Obituary

Charles F. Rohleder, retired Chemist, has died at the age of 87.

Born in New York City, Mr. Rohleder was a 1926 graduate of Cooper Union University in New York. He had been a Chemist with Maas Waldstien in Newark for many years before retiring 20 years ago.

A member of the New York Society for over 40 years, Mr. Rohleder is survived by his wife Edith; a son, Charles; a daughter, Mrs. Catherine A. Oetting; and two grandchildren.

32nd Annual Cleveland Society Technical Conference On Advances in Coatings Held June 6-7, in Cleveland

The Cleveland Society for Coatings Technology held its Annual Conference on Advances in Coatings Technology on June 6-7, at BP America Inc., in Cleveland, OH.

Every year, the Educational Committee of the Society attempts to ascertain those areas in which the most pressing need for technical information currently exists, and secures the services of experts in those areas as lecturers. The audience for the conference was comprised of individuals from varied backgrounds and interests and for this reason the Educational Committee chose to divide the program into four symposia, each with its own central topic: Instrumentation and Methods; Environmental; Pigment Management; and Processing.

Papers presented at this year's conference were:

"NMR Imaging of Interface Complete with Water Penetration"—Jack Koenig, of Case Western Reserve University, Cleveland, OH.

"FTIR Method for Evolved Gas Analysis"—C. Kua and T. Provder, of Glidden Co., Strongsville, OH.

"Correlating Accelerated with Natural Weathering Through FTIR Spectroscopy"—Goutam Gupta, of Applied Research Laboratories, Chicago, IL, and C. Peter Chiang, of Sherwin-Williams Co., Chicago.

"Phase Behavior in Water-Borne Coatings"—Pam Kuschnir, Dick Eley, and F. Louis Floyd, of Glidden Co., Strongsville.

"Coatings in the 90's"—W. Richard Shannon, Jr., of Jamestown Paint and Varnish Co., Jamestown, PA.

"A White Paper on White Lead"—John Weaver, of Case Western Reserve University, Cleveland.

"Radon"—John S. Ruppersberger, of U.S. EPA, Research Triangle Park, NC.

"The Coatings Industry: 1990 and Beyond"—R. Edward Bish, of Jamestown Paint & Varnish, Jamestown.

"Coatings Formulation Using Mixture Design Experiments"—Alain Brisson, of Tioxide Canada Inc., Soral, Quebec, Canada.

"A Practical Application of Hiding Power Efficiency Measurements"—J.G. Dickinson, of E.I. Du Pont de Nemours & Co., Inc., Wilmington, DE.

"Organic Pigments—Future Trends"—Peter Lewis, Sun Chemical Corp., Cincinnati, OH.

"Dispersion of Organic Pigments"—Theodore G. Vernardakis, of Sun Chemical Corp., Cincinnati.

"Mixing Processes in the Protective Coating Industry"—Jim Oldshue, of Mixing Equipment Co., Inc., Rochester, NY.

"Pigment Thickener Interactions in Emulsion Paints"—Alain Brisson.

In preparation for next year's conference, the Educational Committee welcomes papers on all aspects of coatings science and technology including, but not limited to, formulation, testing, application, and characterization. Anyone who wishes to submit a preliminary abstract should do so by September 1989. Send abstracts to Devilla Moncrief, The Sherwin-Williams Co., 601 Canal Rd., Cleveland, OH 44113.

New York Society Cosponsors Course In Coatings Chemistry & Technology

The New York Society for Coatings Technology in conjunction with the Metropolitan New York Paint and Coatings Association are sponsoring an advanced course in coatings chemistry.

The course is designed for those who desire a better understanding of the chemical principles and reactions of coatings. It will cover the chemistry of the major vehicle types, curing reactions, and the design of coatings to meet specific application and performance requirements. The instructor will be Donald E. Brody, of Pyramid Paint Products, Inc., who has been teaching these courses for many years. Mr. Brody is a member of the New York Society.

The course, scheduled to begin on September 6, will be held at Fairleigh Dickinson University in Teaneck, NJ. For further information on the time and registration fees, contact Mildred Leonard, NYSCT Office, 520 Westfield Ave., Ste. 208, Elizabeth, NJ 07208.

CALL FOR PAPERS

Water-Borne and Higher-Solids Coatings Symposium
New Orleans, Louisiana
February 21-23, 1990

The Southern Society for Coatings Technology and the Department of Polymers Science at the University of Southern Mississippi invite all interested persons to submit papers for presentation at the 17th Annual Water-Borne and Higher-Solids Coatings Symposium.

Papers relating to the chemistry, formulation, and marketing of water-borne, higher-solids, and other advanced coating systems are solicited. Papers relating to engineering aspects of coating systems or solvent abatement are also solicited.

Title, abstract, and author's names (speaker's name underlined) should be submitted not later than August 31, 1989 to:

Dr. Robson F. Story, Paper Editor
Department of Polymer Science
University of Southern Mississippi
Southern Station Box 10076
Hattiesburg, MS 39406-0076

The completed paper should be submitted by November 30, 1989. Papers to be presented at the Symposium will be chosen based on abstracts.

It is preferred that all papers be original and of scientific value.

For additional information, call (601) 266-4868 or 266-4869.

R&D Quality Management Seminars Scheduled by Du Pont

Du Pont Management Services, Wilmington, DE, will sponsor a series of five research and development management seminars to be held throughout 1989.

"Strategy of Experimentation" is structured to teach an operational approach to statistical experimental design. This seminar is directed at scientists, quality professionals, engineers, and technical supervisors. Dates and locations for this two- and one-half-day seminar are: July 18-20—Boston, MA; Aug. 8-10—Detroit, MI; Sept. 12-14—San Diego, CA; Oct. 10-12—Chicago, IL; Nov. 14-16—Wilmington; and Dec. 12-14—Dallas, TX.

"Strategy of Formulations Development" is designed to teach the latest technology for planning, analyzing, and interpreting experiments involving mixtures of ingredients. This seminar is directed at scientists, engineers, quality professionals, and technical supervisors. Scheduled dates and locations for this two- and one-half-day seminar are: Sept. 19-21—Chicago; and Nov. 28-30—Wilmington.

"Quality Technology for Managers" is designed to provide an understanding of statistical quality control methods used in business and government and enables attendees to choose the best methods for meeting quality and productivity improvement objectives. The seminar is directed at managers and quality professionals. Dates and locations for this one- and one-half-day seminar are: Oct. 12-13—Chicago; and Dec. 7-8—Wilmington.

"Experimental Design for Quality Improvement" is a computer-intensive seminar on how to meet key product quality goals. The course is structured to teach attendees how to develop or improve product design by using experimental design and analysis software. The seminar is directed at scientists, quality professionals, engineers, and technical supervisors. Scheduled dates and locations for this two-day seminar are: Sept. 13-14—Wilmington; Oct. 24-25—Wilmington; and Dec. 5-6—Wilmington.

"Experimental Design Overview" is a one-half-day, on-site seminar designed to cover the principles, methods, and business importance of experimental design. The seminar is directed at managers, technical supervisors, and quality professionals.

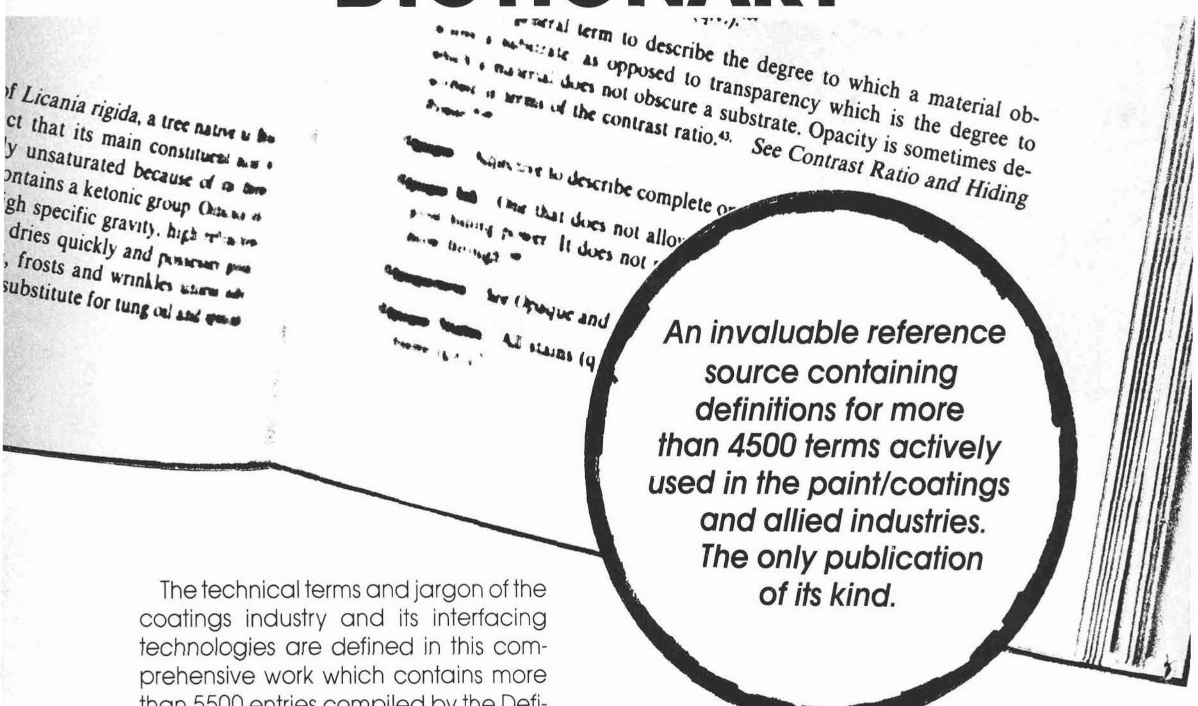
Please direct all inquiries to: James Brock, Du Pont Management Services, Montgomery Bldg., Rm. 235-C, P.O. Box 80800, Wilmington, DE 19880-0800.

In addition, Du Pont has updated the 1989 schedule for its "Process Safety Management" seminar that is designed to teach essential skills needed to conduct process reviews and to identify potential process problems.

The seminar is directed toward process, production, and maintenance engineers, as well as engineers and managers responsible for process reviews. Scheduled dates and locations during the remainder of 1989 will be: July 11-13—Calgary, Alberta, Canada; Aug. 8-10—Wilmington, DE; Oct. 17-19—Philadelphia, PA; and Oct. 31-Nov. 2—San Antonio, TX.

For more information, contact Process Safety Management, Du Pont Management Services, P.O. Box 4500, Greenville, DE 19807.

PAINT/COATINGS DICTIONARY



The technical terms and jargon of the coatings industry and its interfacing technologies are defined in this comprehensive work which contains more than 5500 entries compiled by the Definitions Committee of the Federation of Societies for Coatings Technology. Over 4500 terms are defined, and more than 1000 additional entries are synonyms cross-referenced to the defined terms.

The broad scope of terms included reflects the obvious usefulness of the dictionary to a wide audience, ranging from the layman, to artists and artisans, to technicians in all the coatings-related fields.

A unique feature is classification of terms into one or more of 73 categories, which have been number coded and appear as superscripts following each definition. The terms are listed in their appropriate categories, making up a thesaurus which comprises the second section of the dictionary.

An extensive bibliography of more than 600 references forms the third section.

6x9 in. case-bound. 632 pages
$30.00—Federation Member $50—Non Member

PLEASE MAKE ALL CHECKS PAYABLE IN U.S. FUNDS
Federation of Societies for Coatings Technology • 1315 Walnut Street, Philadelphia, PA 19107

Pennsylvania residents please add 6% sales tax

AVAILABLE IN THE U.K. FROM:
Birmingham Paint, Varnish and Lacquer Club
c/o Mr. Ray Tennant, Carrs Paints Limited, Westminster Works, Alvechurch Rd.
Birmingham B31 3PG, England

Polymer Selection

A new reference book written to aid plastics research and development personnel is in print. The book contains information on polymer selection and design, as well as relating basic structure to resulting properties. "Polymers: Structure and Properties," is available from Technomic Publishing Co., Inc., 851 New Holland Ave., Box 3535, Lancaster, PA 17604.

Packaging Machines

Two machines designed to fill containers ranging from two to five gallons are featured in a technical data sheet. For additional information on the Series 5000 liquid and semi-liquid packaging machines, write Ambrose Co., 2649 151st Place N.E., Redmond, WA 98052.

Microbiocide

Literature introduces a new chemistry designed to offer unique benefits in microbial control for a broad spectrum of systems. For more details on Amerstat® 445, contact John R. Stinger, Manager, Marketing Communications, Drew Industrial Div., One Drew Plaza, Boonton, NJ 07005.

Coulometric Titrator

A microprocessor-controlled, automated titrator which requires no calibration or standardization is the subject of product literature. The unit titrates at greater than 2500 micrograms of water per minute. More facts on the Aquatest 8 Karl Fischer titrator are available from Photovolt, Div. of Seradyn, Inc., P.O. Box 1210, Indianapolis, IN 46206.

Dynamic Analyzer

A redesigned dynamic analyzer is featured in a new product brochure. The literature contains details on the analyzer which measures the viscoelastic properties of polymeric materials to obtain information about the materials' morphology, the key to solving final product performance problems. The brochure on the RDA II is available from the Marketing Dept., Rheometrics, One Possumtown Rd., Piscataway, NJ 08854.

Painting and Coating Systems

A new painting and coating systems catalog is available. The publication details a complete line of coatings for the professional specifier and provides data on coatings systems for interior, exterior, and heavy-duty maintenance applications. To obtain a copy of the "1989 Painting and Coating Systems Catalog," write to the Sherwin-Williams Stores Group, c/o Robert Silverman Co., 1375 Euclid Ave., Cleveland, OH 44115.

Glycol Ethers

Two new glycol ethers are highlighted in a product bulletin. The P-series glycol ethers feature a low degree of toxicity and are low in odor. The products are designed to lower the surface tension of water to enhance wetting action and are coupling agents for oil and water solutions. Data on Dowanol® PnB and/or DPnB glycol ethers are available from The Dow Chemical Co., 2020 Willard H. Dow Center, Midland, MI 48674.

Luster Pigment

Literature introduces a titanium dioxide-coated mica pigment characterized by its very fine particle size. The pearlescent luster pigment is designed to provide coverage combined with high reflectivity. The pigment is available as a nonreactive powder for plastics and surface coating applications. For additional technical information on Mearlin® Satin White, write The Mearl Corp., 41 E. 42nd St., New York, NY 10017.

Interferometer

A new interferometer which features distance and angle measurement is highlighted in a technical data sheet. The interferometer is packaged in one-tenth the size of current interferometers and is designed to minimize stage mass, reduce alignments, eliminate heat sources, and provide high resolution with no limit on acceleration. Information on the Linear/Angular Displacement Interferometer can be obtained from Zygo Corp., Laurel Brook Rd., Middlefield, CT 06455.

Desktop Personal Computer

A computer designed for business and entry-level, computer-aided-design applications is the subject of literature. The 20-MHz desktop personal computer features the power of 32-bit, Intel80386 microprocessor and occupies about two square-feet of desk space. For data on the HP Vectra QS/20 PC, write Hewlett Packard, Public Relations Dept., 3000 Hanover St., Palo Alto, CA 94304.

Filling Machine

Literature introduces a new model filling machine which features a 30-gallon holding tank built into the frame and fills containers from ½ pint to 5 gallons in size. For more information on the Model UCF filling machine, write Beltron Corp., Box 8937, Red Bank, NJ 07701.

Programmable Mixer

A new, bench-top mixer equipped for electronic data acquisition in the laboratory is highlighted in literature. The mixer features a programmable display panel and three interfaces. For more information on the Lighting® LabMaster™ II Model 2510, contact Steve Zimmerman, Mixing Equipment Co., Avon Div., 221 Rochester St., P.O. Box 190, Avon, NY 14414.

Solvent Recovery System

A 100% microprocessor controlled solvent recovery system product line has been introduced in a technical brochure. Models are available from 30-250 U.S.G. capacity. Each unit can be customized to meet individual customer needs. Further information on the SRS™ solvent recovery system can be obtained by writing to CB Mills, 1225 Busch Parkway, Buffalo Grove, IL 60015-5302.

Color Viewing Booth

A portable color viewing booth containing five different light sources for use in a variety of interior and graphic design, retailing and industry applications has been introduced. The viewing booth folds up into a 27-pound impact-resistant carrying case equipped with a soft grip handle. Further information on The Judge™ portable color viewing booth may be obtained from Macbeth, P.O. Box 230, Newburgh, NY 12550.

Water-Based Adhesive Resins

Factors involved in selecting resin dispersions for water-based adhesives are covered in a 12-page, four-color brochure. Key considerations, discussed in detail, include: choosing a resin suited to the backbone polymer and a dispersion system compatible with that of the latex polymer; particle size; film color; pH; softening point; film clarity; and colloidal stability. For a copy of "Products for Water-Based Adhesive Systems," contact Hercules Incorporated, Product Information, Hercules Plaza, Wilmington, DE 19894.

Specification Manual

A 250-page manual designed to provide a set of acceptable standards to assist specifying authorities and contractors who are concerned with painting, wallcovering, and gypsum wallboard finishing of new and existing structures has been published. Approximately 100 finish systems are presented. To order a copy of the "Architectural Specification Manual," contact Painting and Decorating Contractors of America, 3913 Old Lee Highway, Ste. 33B, Fairfax, VA 22030.

Measuring Systems

Two automated, test systems for measuring coating/plating thickness and for statistical process control use have been introduced in literature. The new systems are designed for quality control labs, production line testing, and incoming inspection of electronics, appliance, automotive, and aerospace applications. For more information on the complete Eddy-Mag 2000 product line, contact Chris Horvath, CMI International, 2301 Arthur Ave., Elk Grove Village, IL 60007.

Isocyanates

A full-color, illustrated brochure, describing the advantages of specialty MDI products in formulating polyurethane coatings, adhesives, sealants, and encapsulants, has been issued. The products reportedly offer low viscosity, light color, low temperature storage stability, and crosslinking capacities. Copies of the "C.A.S.E." brochure can be obtained by writing to, K.M. Galbraith, C.A.S.E. Business Area, ICI Polyurethanes, Mantua Grove Rd., West Deptford, NJ 08066.

Product Capability Directory

A 12-page directory, listing individual manufacturing capabilities of a 63 member company by geographical location throughout the world has been published. Among the parameters listed are the company's capacity for coil width, minimum and maximum thickness, coatings, and processing. Individual copies of the "1989-1990 Product Capability Directory," are available free of charge from National Coil Coaters Association, 1900 Arch St., Philadelphia, PA 19103.

Environmental Impact Software

Software which helps plants evaluate how the toxic chemical releases they report under SARA Title III, Section 313 impact nearby communities, has been made available. The program runs on any IBM PC-AT, PC-XT or compatible computer with 640K of memory and a hard disk drive. Write to Du Pont Management Services, P.O. Box 80800, Wilmington, DE 19880-0800, for information on how to obtain the software package, "Environment/Health Impact Screening."

Acrylic Terpolymer Emulsion

A technical brief has been issued detailing a high performance acrylic terpolymer emulsion. Documented are the emulsion's properties and a section on how to calculate the volatile organic content of coatings. Copies of the brochure on 76 RES UC60011 acrylic terpolymer emulsion can be obtained by writing to Unocal Polymers, 1345 N. Meacham Rd., Schaumburg, IL 60196.

Inline Homogenizer

A portable, inline homogenizer for wet processing paints and inks is the subject of recently released technical literature. Standard models include double mechanical-shaft seals and fittings; heating and cooling jackets are available as options. Further information about the Ultrashear™ homogenizer is available from Premier Mill Corp., Exeter Industrial Park, Birchmont Dr., Reading, PA 19606.

Systems Handbook

A handbook containing products for PC-based data acquisition and process control has been published. Included in this edition are A/D converters, multiport serial boards, IEEE-488 interfaces, digital oscilloscope boards, and PC expansion chassis for use with IBM-compatible computer systems. For your copy of "The PC Systems Handbook for Scientists and Engineers," contact CyberResearch, Inc., P.O. Box 9565, New Haven, CT 06536.

Filling Machine

A high-speed filling and sealing machine, which reportedly can fill up to 20 containers per minute of liquid or semi-liquid subtances, has been introduced in technical literature. This unit may be operated in automatic or semi-automatic mode and is available in sanitary models for food applications. Contact Ambrose Co., 2649 - 151st Place, N.E., Redmond, WA 98052, for more information on the Model 512 high-speed filling and sealing machine.

Spectrophotometers

Technical brochures have been issued on two spectrophotometers added to a company's existing product line. For more information on the Chroma Sensor CS-5 and CS-3 spectrophotometers, contact Applied Color Systems, Inc., P.O. Box 5800, Princeton, NJ 08543.

Specialty Coating

A fluoropolymer modified, two part, amine cured epoxy coatings series specially formulated for flue gas desulfurization (FGD) environments, is the subject of recently released literature. The coatings are available in one and five gallon kits and spray applies, in either gray or olive, at 15 mil DFT/coat. For additional information, contact BP Chemicals, Specialty Coatings, 19501 Emery Rd., Cleveland, OH 44218.

Services Directory

A directory listing a company's specialty chemical and petroleum products lines is being offered. A brief profile with sales office and plant addresses for the firm's locations worldwide are also listed. Copies of the directory may be obtained by writing to the Marketing Communications Dept., Witco Corporation, 520 Madison Ave., New York, NY 10022-4236.

Gas Chromatographic System

Recently released literature describes a triglycerides analyzer system for the analysis of fatty acids, glycerides, tocopherois, sterols, and triterpenic acids. Components in the system have been designed for high temperature capillary operation. Further information on the HRGC 5300 Mega Series Triglycerides Analyzer may be obtained by writing to Fisons Instruments, 24911 Avenue Stanford, Valencia, CA 91355.

Dispersers

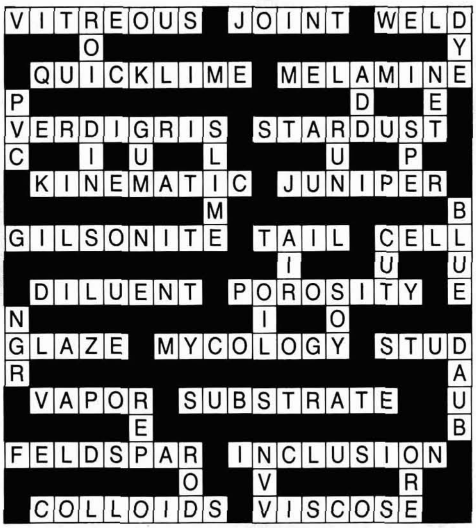
Technical information is available on a new line of dispersers that employ low-heat high efficiency motors, and include solid-state speed controls. The new dispersers are available with either a one-half hp motor or one with a one hp motor. For more information on the complete line of Model 89 Dispersators, write to Premier Mill Corp., Exeter Industrial Park, Birchmont Dr., Reading, PA 19606.

Powdered Pigment Dispersions

Technical data is obtainable on dry powdered pigment dispersions for use in technology coatings, including powder, UV and EB cured, two component, high solids systems, and conventional solvent-thinned coatings. Contact Daniel Products Co., 400 Claremont Ave., Jersey City, NJ 07304, for more information on Tint-Ayd PC powdered pigment dispersions.

Chemical Intermediate

Typical physical properties, suggested applications, and safety and handling guidelines of a chemical intermediate for polyamide, epoxy, and polyurethane applications are outlined in a recently released brochure. Contact Air Products and Chemicals, Inc., Specialty Chemicals Div., 7201 Hamilton Blvd., Allentown, PA 18195-1501, for a copy of the brochure on PACM chemical intermediates.



Solution to June's *"CrossLinks"*

Book Review

ADVANCES IN LOW TEMPERATURE PLASMA CHEMISTRY, TECHNOLOGY, APPLICATIONS—VOLUME 2

Edited by
Herman V. Boenig
Published by
Technomic Publishing Co., Inc.
851 New Holland Ave.
Lancaster, PA 17604 (1988)
vi + 284 Pages, $65.00

Reviewed by
Michael E. Graham
BIRL, Northwestern University
Evanston, IL

This book, much like Volume 1, combines a number of technical papers (9) with a couple of review articles in the plasma processing area. Several of the papers deal with semiconductor technology, including plasma etching polysilicon, silicon nitride synthesis, IR spectra in SiO_2, and transport properties in plasma treated Si-SiO_2 structures. Other subjects include plasma boriding of steel, synthesis of Zn-Sn alloys, plasma modification of polysiloxanes, ESCA characterization of plasma-polymerized TFE, and the effect of plasma to enhance the titanizing process.

The two major articles in the book are first, a mainly theoretical approach exploring the behavior of matter in strong electric fields (field chemistry), and secondly, a review of papers dealing with reactor equipment design for low temperature plasma technology. The electric field paper by Karl Wisseroth, provides good insights to the reactions of chemical species in the presence of strong electric fields and plasmas. Several experimental examples are selected for application of the concepts developed.

The chapter by Boenig covers more than 100 pages of review and includes an extensive bibliography (138 citations). The emphasis tends to be on the electronic and optical applications. Boenig includes sections on basic reactor design, sputtering, oxidation and anodization, plasma assisted epitaxy, organic and metal organic films, plasma-polymerization, polymer surface treatment with plasmas, plasma etching, solar cells, optical wave guides and fibers, and membranes. The referenced articles were published primarily during the period 1976-1984. While Boenig's remarks are brief in most cases, he does often include system schematics from the original authors and as mentioned, the source material is extensive.

The book will be most useful to those currently working in low temperature plasma processing and wishing to keep abreast of the diverse research activity carried on in the international community. The reactor design chapter should prove useful to anyone considering options for their own equipment design.

Coming Events

FEDERATION MEETINGS

For information on FSCT meetings, contact FSCT, 1315 Walnut St., Philadelphia, PA 19107 (215-545-1506).

1989

(Nov. 8-10)—67th Annual Meeting and 54th Paint Industries' Show. New Orleans Hilton and The Rivergate, New Orleans, LA.

1990

(Oct. 29-31)—68th Annual Meeting and 55th Paint Industries' Show. Convention Center, Washington, D.C.

1991

(Nov. 4-6)—69th Annual Meeting and 56th Paint Industries' Show. Convention Center, Toronto, Ontario, Canada.

SPECIAL SOCIETY MEETINGS

1989

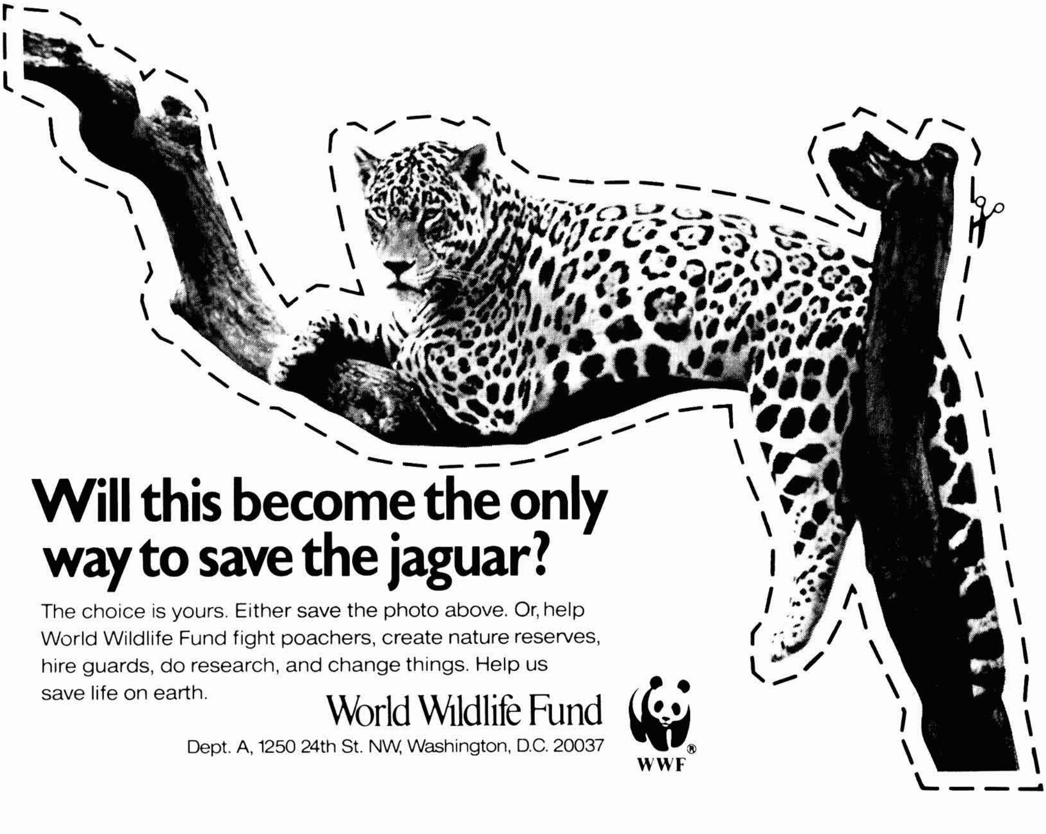
(Aug. 29-30)—Chicago Society SYMCO '89. "Coatings in Compliance." Holiday Inn, Lisle, IL. (Rich Braunshausen, Rust Oleum, 2301 Oakton St., Evanston, IL 60204).

(Sept. 6)—Coating Chemistry & Technology—Fall 1989 course. Co-sponsored by New York Society and Metropolitan New York Paint and Coatings Association. Fairleigh Dickinson University, Teaneck, NJ. (Mildred Leonard, New York Society for Coatings Technology Office, 520 Westfield Ave., Ste. 208, Elizabeth, NJ 07208).

1990

(Feb. 21-23)—Southern Society. 17th Annual Water-Borne and Higher-Solids Coatings Symposium. New Orleans, LA. (Dr. Robson F. Storey, Department of Polymer Science, University of Southern Mississippi, Southern Station Box 10076, Hattiesburg, MS 39406-0076).

(Mar. 14-16)—Southwestern Paint Convention. Houston and Dallas Societies. Doubletree at Post Oak, Houston, TX. (Neil McBride, P.O. Box 841156, Houston, TX 77284-1156).



(Apr. 4-7)—Southern Society. Annual Meeting. Sandestin Beach Hilton, Destin, FL. (James R. Salisbury, Union Carbide Corp., 2043 Steel Dr., Tucker, GA 30084).

1991

(Feb. 18-20)—Western Coatings Societies' 20th Biennial Symposium and Show. San Francisco Hilton, San Francisco, CA.

OTHER ORGANIZATIONS

1989

(July 19-20)—"Paint Volatile Organic Compounds (VOC)" Workshop sponsored by ASTM Standards Technology Training. Holiday Inn—Chicago, Des Plaines, IL. (Kathy Dickinson, ASTM Standards Technology Training, 1916 Race St., Philadelphia, PA 19103).

(July 27-29)—27th Annual Convention of the Oil and Colour Chemists' Association New Zealand. Rotorua, New Zealand. (Mike Rowlands, OCCANZ, P.O. Box 5192, Auckland, New Zealand).

(Aug. 3-6)—31st Annual Convention of the Oil and Colour Chemists' Association Australia. Fairmont Resort, Leura, New South Wales. (Peter Parsons, Tioxide Australia P/L, 2A/6 Tooronga Terrace, Beverly Hills, NSW, Australia 2209).

(Aug. 9-11)—"Radiation Curable Coatings." Short Course sponsored by North Dakota State University, Fargo, ND. (Frank N. Jones, NDSU, Fargo, ND 58105).

(Aug. 21-25)—12th Annual "Advances in Emulsion Polymerization and Latex Technology" Short Course. Schatzalp Berghotel, Davos, Switzerland. (Gary W. Poehlein, Graduate Office [Savant], Georgia Institute of Technology, Atlanta, GA 30332–0265).

(Aug. 21-25)—"Electroplating and Surface Finishing for Electronic Applications." Course sponsored by the American Electroplaters and Surface Finishers Society. Hyatt Palo Alto, Palo Alto, CA. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(Aug. 22-26)—"Surface Phenomena and Fine Particles in Water-Based Coating and Printing Technology." International Symposium sponsored by the Fine Particle Society. Marriott Copley Place, Boston, MA. (Mahendra K. Sharma, Research Laboratories, Eastman Kodak Co., Box 1972, Kingsport, TN 37662, or F.J. Micale, Sinclair Laboratory, Bldg. 7, Lehigh University, Bethlehem, PA 18015).

(Sept. 6-7)—"Introduction to Electroplating and Surface Finishing." Training course sponsored by the American Electroplaters and Surface Finishers Society. Ramada Inn Oakbrook 3, Elmhurst, IL. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(Sept. 11-15)—"Laboratory Corrosion Testing." Short Course sponsored by the Southwestern Ohio Section of NACE and NACE/Fontana Corrosion Center at Ohio State. Ohio State University, Columbus, OH. (John Beavers, 2704 Sawbury Blvd., Columbus, OH 43235, or Steve Corey, 1020 W. Park Ave., Kokomo, IN 46901).

(Sept. 12-14)—Haztech International Fourth Annual Conference and Exhibition. Cincinnati Convention Center, Cincinnati, OH. (Rachelle Scheinbach or Ursula Barril, Haztech International, 13555 Bel-Red Rd., C-96870, Bellevue, WA 98009).

(Sept. 14-15)—"Waste Treatment Simplified." Course sponsored by the American Electroplaters and Surface Finishers Society. Ramada Inn Chandler, Chandler, AZ. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(Sept. 18-22)—"Electroplating and Surface Finishing." Training course sponsored by the American Electroplaters and Surface Finishers Society. Ramada Inn Oakbrook 3, Elmhurst, IL. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(Sept. 23-28)—12th World Conferences on Non-Destructive Testing sponsored by the Dutch Non-Destructive Testing Society. RAI International Exhibition and Congress Center, Amsterdam, The Netherlands. (RAI International Exhibition and Congress Center, Europaplein, 1078 GZ, Amsterdam, The Netherlands).

(Sept. 25-27)—Third Annual Hazardous Materials Management Conference and Exhibition of Canada (HazMat/Canada '89). Harbour Castle Westin Conference Centre, Toronto, Ont., Canada. (Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E—Suite 408, Glen Ellyn, IL 60137-5835).

(Sept. 25-29)—"Electroplating and Surface Finishing for Electronic Applications." Course sponsored by the American Electroplaters and Surface Finishers Society. Sheraton University Center, Durham, NC. (Sylvia L. Baxley, AESF, Central Florida Research Park, 12644 Research Parkway, Orlando, FL 32826).

(Sept. 25-30)—American Chemical Society. 196th National Meeting. Los Angeles, CA. (B.R. Hodson, ACS, 1155—16th St. NW, Washington, D.C. 20036).

(Sept. 26-27)—Finishing '89. Telford Exhibition Center, Telford, Shropshire, England. (Nigel Bean, Turret Group Plc, Turret House, 171 High St., Rickmansworth, Herts, WD3 1SN).

(Sept. 26-28)—"Inspection of Coatings and Linings for Immersion Service" Course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Sept. 27-29)—Liquitec Expo '89 (Carolyn Mesce, Liquitec Expo, P.O. Box 630, West Paterson, NJ 07424).

(Sept. 27-29)—Haztech International Fourth Annual Conference and Exhibition. San Francisco Civic Auditorium, San Francisco, CA. (Rachelle Scheinbach or Ursula Barril, Haztech International, 13555 Bel-Red Rd., C-96870, Bellevue, WA 98009).

(Oct. 4-6)—National Coil Coaters Association (NCCA) Fall Meeting. Hyatt Regency at O'Hare Airport, Chicago, IL. (NCCA, 1900 Arch St., Philadelphia, PA 19103).

(Oct. 23-25)—"High-Coatings." 9th International Conference of the Paint Research Association. Sheraton Hotel, Frankfurt, West Germany. (Dip Dasgupta, Head of Information Dept., PRA, 8 Waldegrave Rd., Teddington, Middlesex TW11 8LD, England).

(Oct. 24-26)—8th International Conference on the Internal and External Protection of Pipes. Cosponsored by BHRA and Snamprogetti. Florence, Italy. (Conference Organizer (Pipe Protection), BHRA, The Fluid Engineering Centre, Cranfield, Bedford MK43 OAJ, England).

(Oct. 31-Nov. 2)—"Maintenance/Industrial Painting Practices" Course sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, Inc., 115 Technology Dr., Pittsburgh, PA 15275).

(Nov. 1-2)—"Paint Volatile Organic Compounds (VOC)" Workshop sponsored by ASTM Standards Technology Training. ASTM Headquarters, Philadelphia, PA. (Kathy Dickinson, ASTM Standards Technology Training, 1916 Race St., Philadelphia, PA 19103).

(Nov. 6-7)—25th Annual Symposium of ASTM Committee G-1. Orlando, FL. (Symposium Chairman Robert Baboian, Texas Instruments, Inc., Electrochemical and Corrosion Laboratory, Mail Station 10-13, Attleboro, MA 02703, or Sheldon W. Dean, Jr., Air Products and Chemicals, Inc., P.O. Box 538, Allentown, PA 18105).

(Nov. 6-8)—National Paint & Coatings Association Annual Meeting. New Orleans Hilton Hotel, New Orleans, LA. (NPCA, 1500 Rhode Island Ave., N.W., Washington, D.C. 20005).

(Nov. 7-9)—Hazardous Materials Management West Conference and Exhibition. Long Beach Convention Center, Long Beach, CA. (Brenda O'Neal, Show Manager, Tower Conference Management Co., 800 Roosevelt Rd., Bldg. E—Suite 408, Glen Ellyn, IL 60137-5835).

(Nov. 18-20)—National Decorating Products Show sponsored by the National Decorating Products Association. McCormick Place, Chicago, IL. (Lillian Smysor, NDPA, 1050 N. Lindbergh Blvd., St. Louis, MO 63132-2994).

(Nov. 28-30)—"Level II—Industrial Maintenance Course" sponsored by KTA-Tator, Inc., Pittsburgh, PA. (KTA-Tator, 115 Technology Dr., Pittsburgh, PA 15275).

(Nov. 28-Dec. 1)—The Inter-Society Color Council Williamsburg Conference. Williamsburg, VA. (Roy Berns, Rochester Institute of Technology, P.O. Box 9887, Rochester, NY 14623-0887).

1990

(Feb. 18-21)—Adhesion Society Annual Meeting. Sheraton Savannah Resort and Hotel, Savannah, GA. (Adhesion Society President Jim Wightman, Dept. of Chemistry, VPI & SU, Blacksburg, VA 20461).

(Mar. 13-15)—Electrocoat/90. Drawbridge Inn and Convention Center, Ft. Mitchell, KY. (Cindy Puthoff or Anne Goyer, Gardner Management Services, 6600 Clough Pike, Cincinnati, OH 45244).

(Mar. 25-29)—RadTech '90—North America. Radiation Curing Conference and Exposition. Hyatt Regency Chicago, Chicago, IL. (RadTech International North America, 60 Revere Dr., Suite 500, Northbrook, IL 60062).

(Apr. 2-6)—11th International Corrosion Congress. Florence, Italy. (AIM—Associazione Italiana di Metallurgia, Piazzale Rodolfo Morandi, 2, I-20121 Milano, Italy).

(May 2-9)—Surface Treatment '90. Hannover Fairgrounds, Hannover, West Germany. (Hannover Fairs USA Inc., 103 Carnegie Center, Princeton, NJ 08540).

(May 14-15)—"Analysis of Paints and Related Materials." Symposium sponsored by ASTM Committee D-1. Pittsburgh, PA. (Marsha Firman, ASTM, 1916 Race St., Philadelphia, PA 19103).

1991

(Feb.)—Inter-Society Color Council Williamsburg Conference. Williamsburg, VA. (Louis A. Graham, Lou Graham & Associates, Inc., 1207 Colonial Ave., Greensboro, NC 27408).

Advertisers Index

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'Humbug' from Hillman

Bill Tomc was recently tempted to come out of retirement and apply for a job advertised in the Cleveland Plain Dealer by the U.S. Department of Housing and Urban Development, to wit:

"Wanted—Defective Paint Inspector"

However, Bill was nonplussed in submitting his application as to whether his years in the paint industry entitled him to claim that he was defective or that he had much experience with defective paint. In any event, it appears that Bill decided that continued retirement was the better part of valor.

And—speaking of Cleveland—Sid Lauren was intrigued by an abstract in the Cleveland Society's program for their 32nd Annual Technical Conference. Sid writes, "Here, then, is a quote from the abstract of a paper titled, 'Coatings Formulation Using Mixture Design Experiments':

'A coating is a complex mixture of pigment, binder, extender, solvent and addictives.'

Is there a paint—pardon, coatings—chemist alive who hasn't worried about his addiction to additives? They compose a class of materials that we sometimes feel we can't live with—or without."

Sid, it seems, also had his memory jogged by a one liner in Postscripts of the *C&E News,* which told of an announcement of a lecture, "Surprises in Obstetrics." Someone had pencilled in "Mary had a little lamb." Sid's recall (back to grade school) brought this version to his mind—"Mary had a little lamb. The doctor had a fit."

Speaking of addiction, our readers may remember Dick Twomey and his addiction for inspirational poetry. Well, this month he has sent us a poem that is less inspirational and more to the point for so many of the lab slaves. It was discovered by Paul Berens, who is described as semi-retired from the Touraine lab—with a good memory.

Paint chemist, paint chemist, miracle man
Make me some paint as fast as you can.
To dry in ten minutes and last for ten years;
Flow out to perfection, but no sign of tears.

Paint chemist, paint chemist, grind it so fine,
Minimum Hegeman gauge reading, nine.
No settling, no skinning, no float, and no flood,
Resistance to everything, better than good.

Paint chemist, paint chemist, what do you say?
Ten gallons, ten colors wanted today.
Spray, brush, or dip and roller coat, too,
Five bucks a gallon will just about do.

Paint chemist, paint chemist, did I forget?
No smell, no fumes, or the workers will fret.
And film must be lethal to molds and bacteria,
Good Heavens, the fellow's gone into hysteria.

Philosopher Dick Kiefer takes us from the less than inspirational to the dessert———humble pie, that is!

Sometime when you're feeling important
Sometime when your ego's in bloom.
Sometime when you take it for granted.
You're the best qualified in the room.

Sometime when you feel you're going
Would leave an unfillable hole,
Just follow this simple instruction
And see how it humbles your soul.

Take a bucket and fill it with water
Put your hand in up to the wrist.
Take it out—and the hole that's remaining
Is a measure of how you'll be missed.

You can splash all you please as you enter
You can stir up the water galore,
But stop—and you'll find in a minute
That it looks quite the same as before.

There's a moral in this quaint example
Just do the best that you can
Be proud of yourself but remember
There is no indispensible man.

Paint chemist, paint chemist,—a suggestion for you,
Show your boss the first poem, not number two.

—Herb Hillman
Humbug's Nest
P.O. Box 135
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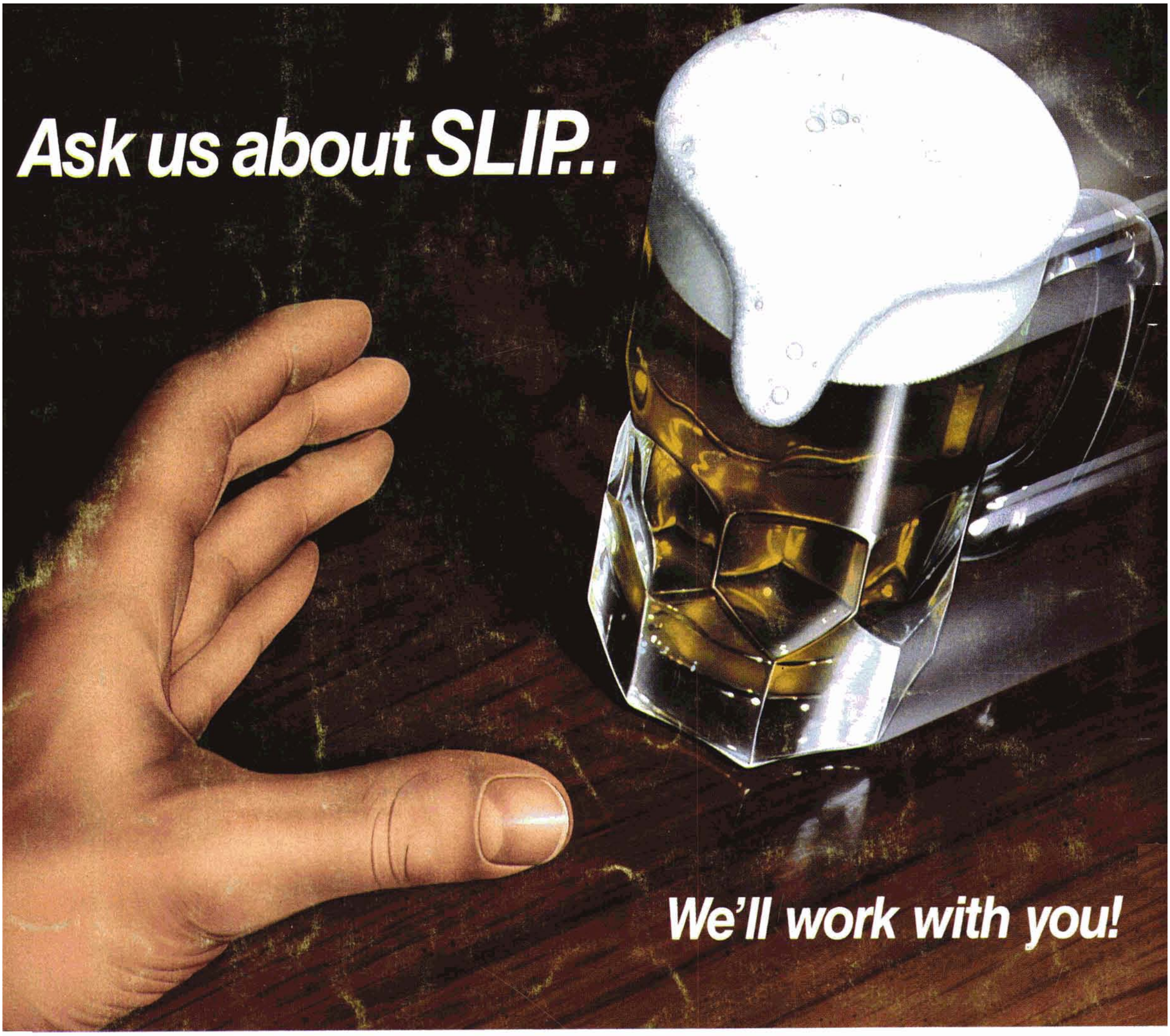

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